HEATING & VENTILATING
AIR CONDITIONING

CONTENTS

FOR SEPTEMBER, 1937

Industrial Exhaust Ventilation—Flow of Fluids 39
Will Room Cooler Cabinets Follow Radio's Example? . . 45
New York Contractors Operate Under Code 46
Feeding Device for Boiler Compound 47
Electric Motors for Air Conditioning Applications . . . 48
A Study of the Weather in Washington, D. C. 52
Waterless Boilers 56
Simplified Method of Sizing Refrigeration Piping . . . 57
Air Conditioning the Newspaper Plant 63
Improved Ventilation for London Subways 64
Air Conditioning the Merchandise Mart 65
Steam Traps and Their Characteristics 69
Editorials 72
Engineering Notebook 73
Reference Data, 109 and 110 74
What Readers Say 75
Abstracts 77
News of the Month 79
New Equipment 80
Summer Degree-Hours for July, 1937 86
The Weather for July, 1937 88
With the Manufacturers 90
New Catalogs 92
Coming Events 94

For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning.

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HEATING & VENTILATING is published monthly by The Industrial Press, Robert B. Luchars, President; Edgar A. Becker, Vice-President and Treasurer; Erik Oberg, Secretary. Published at 148 Lafayette Street, New York, N. Y. Western Office, 228 North La Salle Street, Chicago, Ill. Yearly subscription in United States and Mexico, $2.00; in Canada, $2.50; in all other countries, $3.00. Single copies, 30 cents. Member of Audit Bureau of Circulation and Associated Business Papers.

VOLUME 34 NUMBER 9

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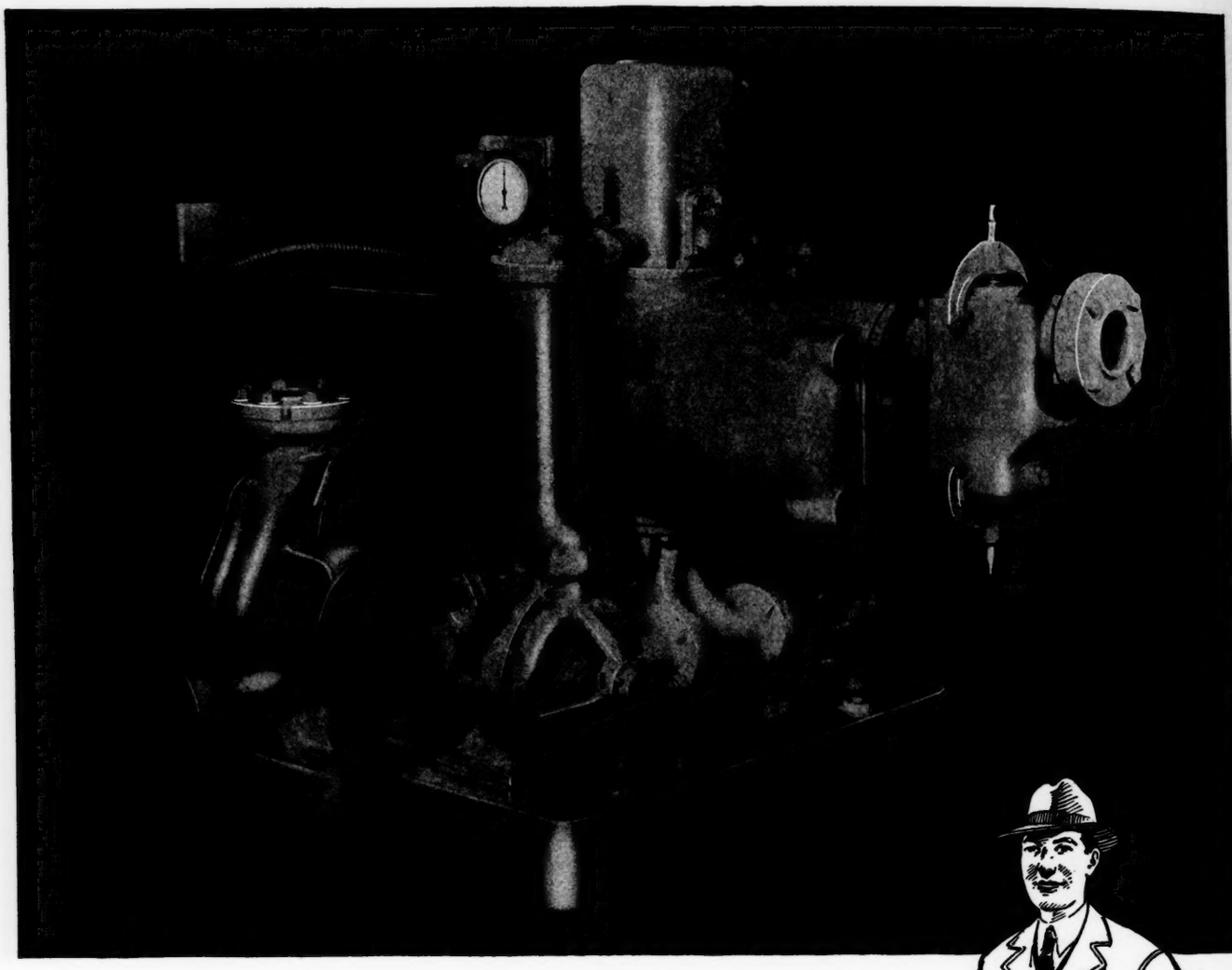
THIS ECONOMICAL HEATING PUMP OPERATES WITHOUT ELECTRIC CURRENT



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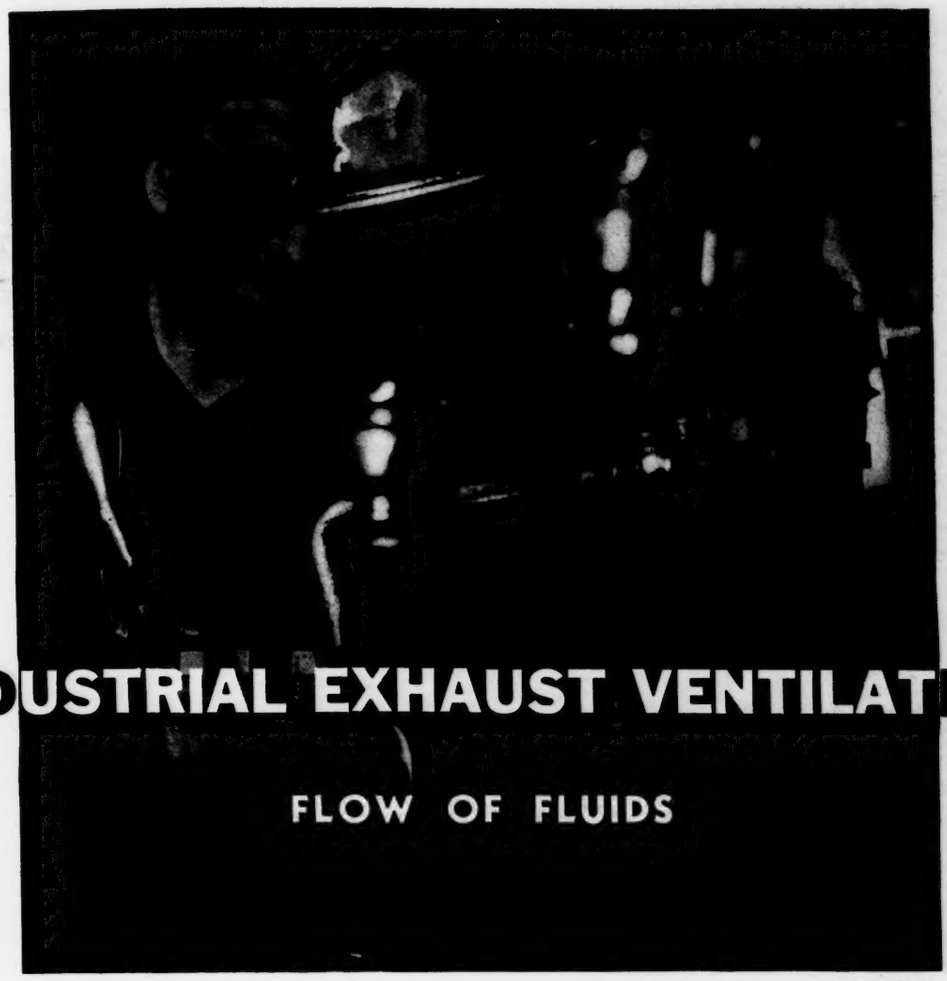


INDUSTRIAL EXHAUST VENTILATION

FLOW OF FLUIDS

Galloway

By JOHN L. ALDEN

THE term "exhaust system" as applied to certain types of low-pressure industrial pneumatic systems is not accurately defined but usually is interpreted as including dust collecting, fume removal and low-pressure conveying systems. Heating, ventilating and air conditioning systems are definitely excluded. A general characteristic of exhaust systems is that the fluid flowing through the piping is not homogeneous. It is a mixture, usually of air as the parent fluid, carrying solids in suspension or vaporous or gaseous materials. Broadly, an exhaust system is a pneumatic conveying system even though its primary purpose may be quite different from the mere transportation of materials.

The characteristics of the system and its design problems are dictated principally by the laws of flow of the conveying fluid. Knowledge of these laws is fundamental equipment for the competent designing engineer. Admittedly, simple systems of the types covered by state codes may be constructed without specific reference to the principles of fluid flow. Nevertheless, a thorough understanding of the basic theory is essential to the successful solution of the unconventional problem or to the refinement of design which distinguishes the truly good job from the merely passable. A speaking acquaintance with the fundamentals is desirable even for the buyer of exhaust systems if only to test the competence of the contractor-designer.

A word about the author. Mr. Alden, now Superintendent of Manufacturing Engineering, Kearny Works, Western Electric Company, has been interested and active in industrial exhaust ventilation for nearly twenty-five years. Here he summarizes the latest information on fluids flowing in industrial exhaust systems, shows that flow in such systems is always turbulent, and that the presence of solids in the air stream can usually be ignored in the design of dust collecting systems.— Editor

Functions of the Conveying Fluid

The conveying fluid not only transports the material to its destination but also is instrumental in introducing the material into the system initially. Flying dust particles are deflected into the mouth of the hood by the entering air stream. Other particles, already at rest, are set in motion in the desired direction.

Air flow past a dust particle is essential if the particle is to abandon a state of rest for one of motion. The forces necessary to encourage or control motion are those of air currents and not the imaginary but often quoted "sucking power" of the fan. The sole purpose of the fan suction or partial vacuum is to cause air to flow into the hood with the required velocity. A partial vacuum is a purely static

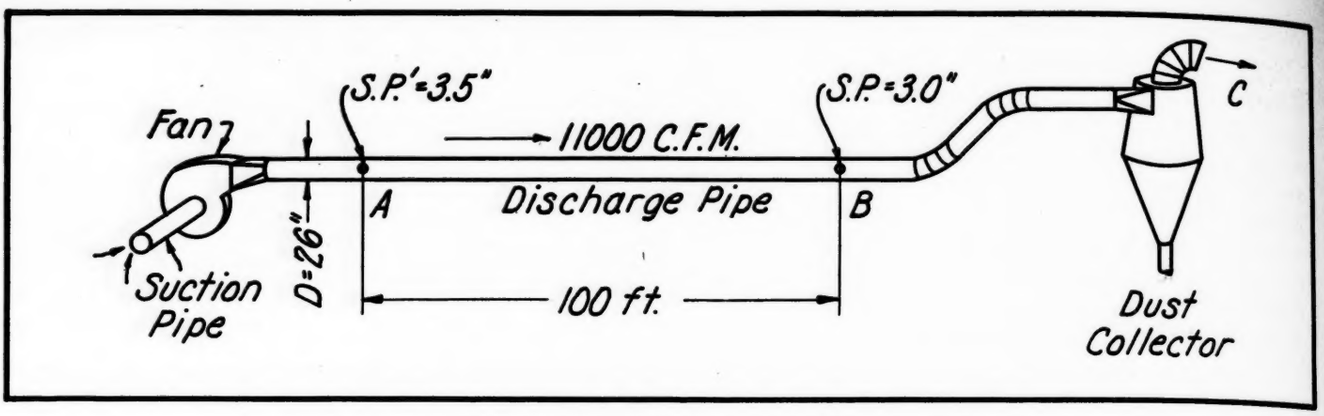


Fig. 1. Diagram illustrating drop in static pressure due to friction

phenomenon. It has no ability to set a particle in motion or to deflect one in flight. It seems necessary to emphasize the dynamic character of dust exhausting because of the common misconception of the mechanics of vacuum cleaning and similar processes.

Standard Air

In the following pages standard air will be taken as being air whose density is 0.07488 lb. per cu. ft., corresponding to a barometric pressure of 29.92 in. of mercury, a dry bulb temperature of 68F and 50% relative humidity. These values are identical with those quoted in the Standard Test Code for Disc and Propeller Fans, Centrifugal Fans and Blowers, adopted by the National Association of Fan Manufacturers and the ASHVE. In the discussion of fluid flow which follows, the fluid is standard air unless specifically stated otherwise.

Compressibility

Air, of course, is compressible. Nevertheless, during the study of flow phenomena it will be considered as incompressible. The development of the laws of flow is simplified thereby without loss of validity. Furthermore, the assumption of incompressibility introduces no important errors into the practical expressions for friction losses, power, air volume, and other design factors. The pressure in exhaust systems is seldom more than 6 in. of water above or below atmospheric pressure. Since the latter for standard air is 408 in. of water, the degree of compression or rarefaction and hence the error in density, volume or velocity introduced by the incompressibility assumption does not usually exceed 1½%. Other uncertainties such as operating temperatures and humidities, exact pipe diameters and unpredictable degrees of pipe roughness may combine to produce considerably greater errors.

Suspended Solids

The presence of dust and other conveyed solids is ignored in the development of the fluid laws. Their presence may be neglected in the practical design of dust collecting systems wherein the ratio of solids to air is low. The extent to which the designer is justified in ignoring the effect of solids on fluid friction will be treated more fully later.

Static, Velocity and Impact Pressures

A unit mass of fluid flowing through a pipe is acted upon simultaneously by two distinct pressures. One, known as "static" pressure, is the force tending to compress the fluid. The other, "velocity" pressure, is that pressure which was required to accelerate the flowing mass from rest to its existing velocity. Conversely, it may be defined as the pressure opposing flow necessary to bring the flowing mass to rest. Velocity pressure acts only in the direction of flow. Static pressure, on the other hand, acts equally in all directions, tending not only to compress the fluid but to burst the pipe as well. A third pressure, known as "impact," "total," or "dynamic" pressure or head, is the sum of the static and velocity pressures acting simultaneously at a given point in a piping system. Because it contains a velocity component, impact pressure, also, is measured in the direction of flow.

Units of Pressure, Velocity and Volume

The customary unit of pressure in exhaust work is the inch of water in a "U" shaped tube or manometer. One inch of water equals 69.3 ft. of standard air. Pressures too high to be measured conveniently with a water filled "U" tube are measured by a mercury manometer. One inch of mercury is equivalent to 13.6 in. of water. The ounce per square inch has little to recommend it as a unit of pressure. Velocities are usually expressed in feet per minute and volume rates of flow in cubic feet per minute, abbreviated as f.p.m. and c.f.m., respectively.

Static Pressure a Measure of Resistance

The pressure used in overcoming resistance to flow is the static pressure. Hence, static pressure is sometimes called "frictional" or "resistance" pressure. The measure of fluid friction in a pipe is the drop in static pressure from one cross sectional plane to a similar downstream plane. Thus, in Fig. 1, 0.5 in. of water of static pressure is employed to force 11,000 c.f.m. through 100 ft. of 26-in. pipe from A to B. The static pressure at A, 3.5 in. of water, is the sum of all resistances between A and the atmosphere at C. Similarly, the 3-in. static pressure at B is the sum of all piping friction, collector back pressure and other resistances between B and the atmosphere.

Measurement of Pressures

Static pressure is measured at right angles to the direction of flow in order to avoid the influence of the fluid velocity. The small hole through the pipe wall in Fig. 2, connected to a manometer, is a typical device for measuring static pressure. Velocity pressure is more difficult to measure because it cannot be separated from the static pressure which always accompanies it. The only exception is a measurement made at the open end of a pipe discharging to the atmosphere in which case the static pressure is zero. To obtain the velocity pressure in a pipe it is necessary to measure the impact pressure and the static pressure occurring simultaneously. The difference constitutes the velocity pressure.

In Fig. 3 an impact tube, A, is shown pointing directly upstream. The manometer to which it is connected registers not only the velocity pressure acting axially of the pipe but also the superimposed static pressure. A separate measurement of static pressure is made as at B. Subtracting the static from the impact pressure leaves the velocity pressure. The conventional Pitot tube with its self-contained impact and static openings can be connected to a single manometer in such manner as to indicate the velocity pressure directly.

Relation of Velocity Pressure to Velocity

The velocity pressure, if measured in feet of air column, represents the height to which a particle of air would be raised if all of its energy of motion were expended in raising it against the force of gravity. The velocity of an air particle falling from this height is

$$v = \sqrt{2gh}$$

where v = velocity, ft. per sec.,

g = acceleration due to gravity, 32.16 ft. per sec.^{2}

h = velocity pressure, ft. of air.

When the velocity and pressure are expressed as f.p.m. and in. of water, this equation becomes

$$V = 4008\sqrt{H}$$

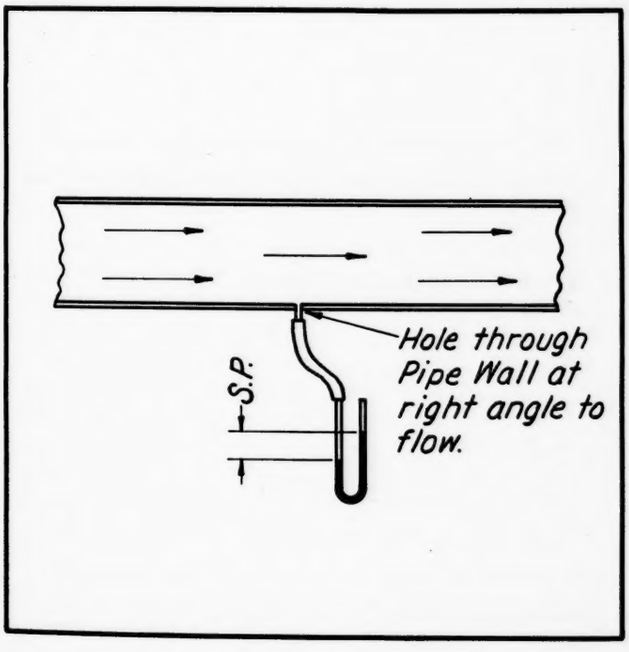
for standard air. This expression has wide application in exhaust practice.

Bernouilli's Theorem

The pressures associated with a given volume of fluid are directly proportional to the energy content of that fluid. The velocity pressure is a measure of the kinetic energy or energy of motion. The static pressure is a measure of the potential energy. The impact pressure, comprising the sum of the static and velocity pressures, is therefore a measure of the total energy of the fluid volume. Since potential and kinetic energies are mutually convertible, static pressure may be transformed into velocity pressure and vice versa. This is the foundation of Bernouilli's theorem which states that, neglecting losses, the impact pressure at any point in a pipe is equal to the impact pressure at any other point. Thus, regardless of the varying proportion of static and velocity pressures, their sum (impact pressure) is constant throughout the length of the pipe if energy is neither gained nor lost.

Let Fig. 4 represent a pipe with a constriction which causes the velocity at B to be greater than that at A, so that the velocity pressure has increased from 1.5 in. of water at A to 2.5 in. at B. The static pressure at A is 2.0 in., making the impact pressure at that point 3.5 in. of water. From Bernouilli's theorem, the impact pressures at B and C must also be 3.5 in. The static pressures at B and C then become 1.0 and 1.5 in. of water, respectively.

Bernouilli's theorem is of considerable practical importance to the designer of exhaust systems. While theoretically perfect conversions of velocity to static pressure never occur, the conversion in impact tubes, metering nozzles and a few other structures is so near-



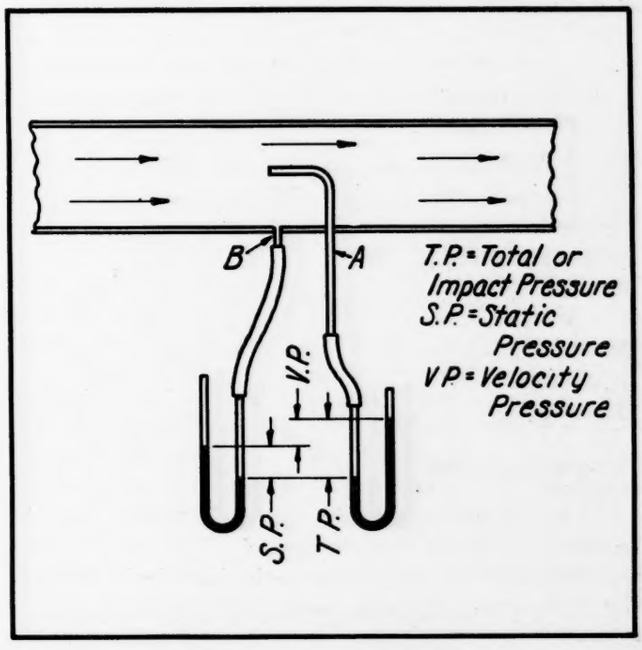
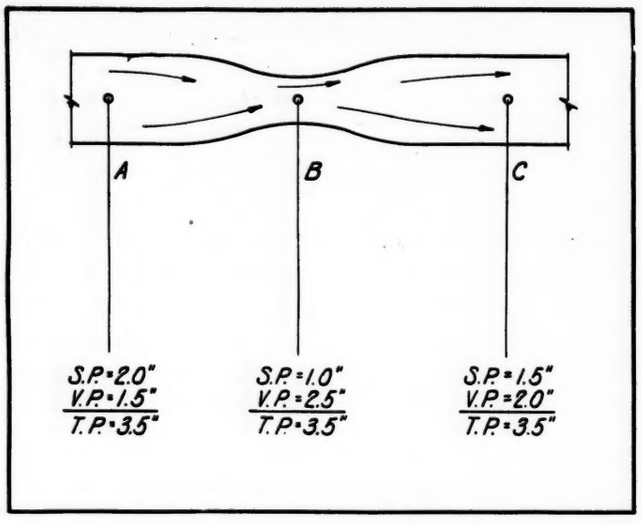


Fig. 2. (Left) Typical device for measuring static pressure. Fig. 3. (Right) Typical arrangement for measuring static and impact pressures.



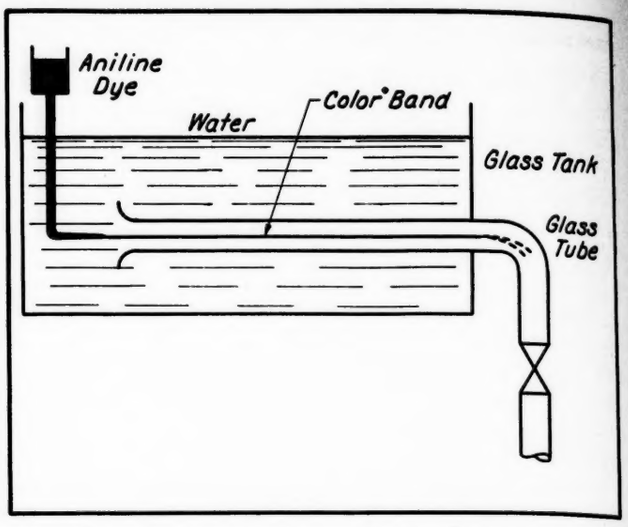


Fig. 4. (Left) Diagram illustrating the total pressure is steady at all cross-sections. Fig. 5. (Right) Reynolds color band apparatus.

ly perfect that this theorem applies almost without correction. Considerable departure from perfect conversion may take place in tapers, transformers, traps, and other commercial fittings in which appreciable velocity changes occur. In such instances, the degree of departure from Bernouilli's theorem is the measure of the static pressure losses.

Nature of Fluid Flow

When a fluid flows through a pipe at very low velocities, the particles follow predictable paths free from eddies or swirls. The flow then is said to be "streamline," "viscous," or "laminar." As the velocity increases, the character of flow changes; eddies form; and the paths of the fluid filaments are sinuous and swirling. This type of flow is known as "turbulent" flow. Each type of flow has its own laws of resistance to motion. These laws apply to all fluids, including water, air and oil, regardless of the individual characteristics of the fluid.

It must be understood that the turbulent state of flow is one of minute whirls, sinuosities and vortices. The turbulence of which we speak is microscopic rather than macroscopic. It has been observed, for example, that sinuous motion of fluid laminae exists as close as 0.000025 in. from the wall of a smooth pipe during the turbulent state. The turbulence of which we speak is not that caused by poor design or workmanship of the piping system. It is an inescapable condition always existing when the velocity exceeds certain critical values even though the pipe be drawn glass tubing of the utmost smoothness.

A brief description of the color band experiments of Osborne Reynolds[1] will help to visualize the characteristics of laminar and turbulent flow. These were conducted for the purpose of locating the zone of transition from one type to the other. The apparatus is illustrated schematically in Fig. 5. For convenience, the fluid used was water although the principles illustrated apply equally well to other fluids.

[1] "Water—Direct and Sinuous Flow," by Osborne Reynolds, Philosophical Transactions of the Royal Society, Vol. 176, 1883, pp. 935-984.

The apparatus consisted of a glass tank into the side of which was sealed a glass exit tube with a well-rounded inlet. A valve in the exit tube regulated the rate of flow. A small tube entering the inlet zone introduced a thin filament of aniline dye into the flowing stream.

At low water velocities the colored filament extended the full length of the tube and was sharply defined as though motionless in the slowly moving stream. As the velocity increased, the filament attenuated until a speed was reached at which eddies began to form at the outlet end. Further increase in velocity caused the eddies progressively to approach the inlet until finally the entire stream was in violent motion.

Critical Velocity

The velocity at which eddies begin to form, as determined by the color band experiment, is called the "higher" critical velocity. The "lower" critical velocity is that at which eddies die out when the velocity of turbulent flow is reduced slowly. Between these boundary speeds lies an unstable zone in which the flow may be either laminar or turbulent. The existence of two distinct values of the critical velocity indicates a pronounced tendency for the existing state of flow to persist even after passing the critical speed. The lower critical velocity is the more definite of the two and is usually taken as the true critical velocity.

A second zone in which flow phenomena undergo a change is the region close to the velocity of sound in the fluid. For air, this is about 1100 ft. per sec. which is far beyond the highest velocities found in exhaust systems. This region is of principal concern to the ballistics engineer, since in this zone the drag coefficient of projectiles increases to about three times the values existing at lower speeds.

Empirical Friction Formulas

The problem of resistance to fluid flow has attracted many experimenters because of the importance of friction losses in the design of piping systems. Most of the analytical work in this field during the past 200 years has been devoted to fitting empirical formulas to experimental data. The result has been a large num-

ber of formulas for pressure drop, each fitting a limited range of pipe sizes and velocities and peculiar to a specific fluid. For example, Kemler[2] lists 91 values of the friction factor, f, used by authorities who have proposed making it a constant. It is evident that nothing but confusion could result for the engineer seeking reliable data for piping design.

Reynolds' Dimensional Analysis

No common basis for comparison of flow data existed until Reynolds in 1883 made use of the principle of dynamic similarity originated by Newton. Reynolds' work was lost sight of until 1914 when Stanton and Pannell[3] employed his methods in analyzing the data resulting from their elaborate experiments on a variety of fluids. They showed that Reynolds' method of dimensional analysis was both theoretically and practically correct and that a single formula, dimensionally homogeneous, applies to all fluids. Their conclusions are fully verified by later research and by analyses of past data by Kemler and by Pigott.[4]

Reynolds Number

Briefly stated, dynamic similarity is attained in two or more conditions of flow through smooth pipes if a dimensionless quantity called the "Reynolds Number" is the same in both cases. This fact enables flow data to be compared on the basis of the Reynolds number which takes into account the essential physical properties of the fluid, the diameter of the tube and the fluid speed.

The factors affecting pressure loss due to friction in a pipe are pipe diameter and length, fluid density and viscosity and the velocity of flow. The friction loss of head may be expressed as

$$\Delta p = w \Delta h = \frac{flwv^2}{2gd}$$

which is known as the "dimensional" formula. The friction factor, f, in this equation must be dimensionless if the principle of dimensional homogeneity is to be satisfied. Reynolds showed that f must be a function of $vdw/\mu = R$, the Reynolds number.

Δp = pressure drop, lb. per ft.^{2},
Δh = pressure drop, ft. head of fluid,
w = density of fluid, lb. per ft.^{3},
f = friction factor, dimensionless,
l = length of pipe, ft.,
v = velocity of fluid, ft. per sec.,
g = acceleration of gravity, 32.16 ft. per sec.^{2},
d = diameter of pipe, ft.,
R = Reynolds number, dimensionless,
μ = absolute viscosity of fluid, lb. per sec. per ft.

The Reynolds number has been a useful tool not only to researchers in the field of fluid flow but to practicing engineers as well. It has reduced much empirical data to a rational basis. Moreover, it has been the means of reconciling conflicting friction formulas since it has been shown that seemingly unrelated values for oil, water, air, gas, tar, and similar substances, fall on a common curve when plotted against the Reynolds number.

Critical Reynolds Number

It has been found that laminar flow is stable against all disturbances at R = 1160 or below. The upper

[2] "A Study of the Data on the Flow of Fluids in Pipes," by Emory Kemler, ASME Transactions, 1933, paper No. HYD-55-2.

[3] "Similarity of Motion in Relation to the Surface Friction of Fluids," by T. E. Stanton and J. R. Pannell, Philosophical Transactions of the Royal Society of London, Vol. A-214, 1914, pp. 199-244.

[4] "The Flow of Fluids in Closed Conduits," by R. J. S. Pigott, Mechanical Engineering, Vol. 55, No. 8, Aug. 1933, pp. 497-501, 515.

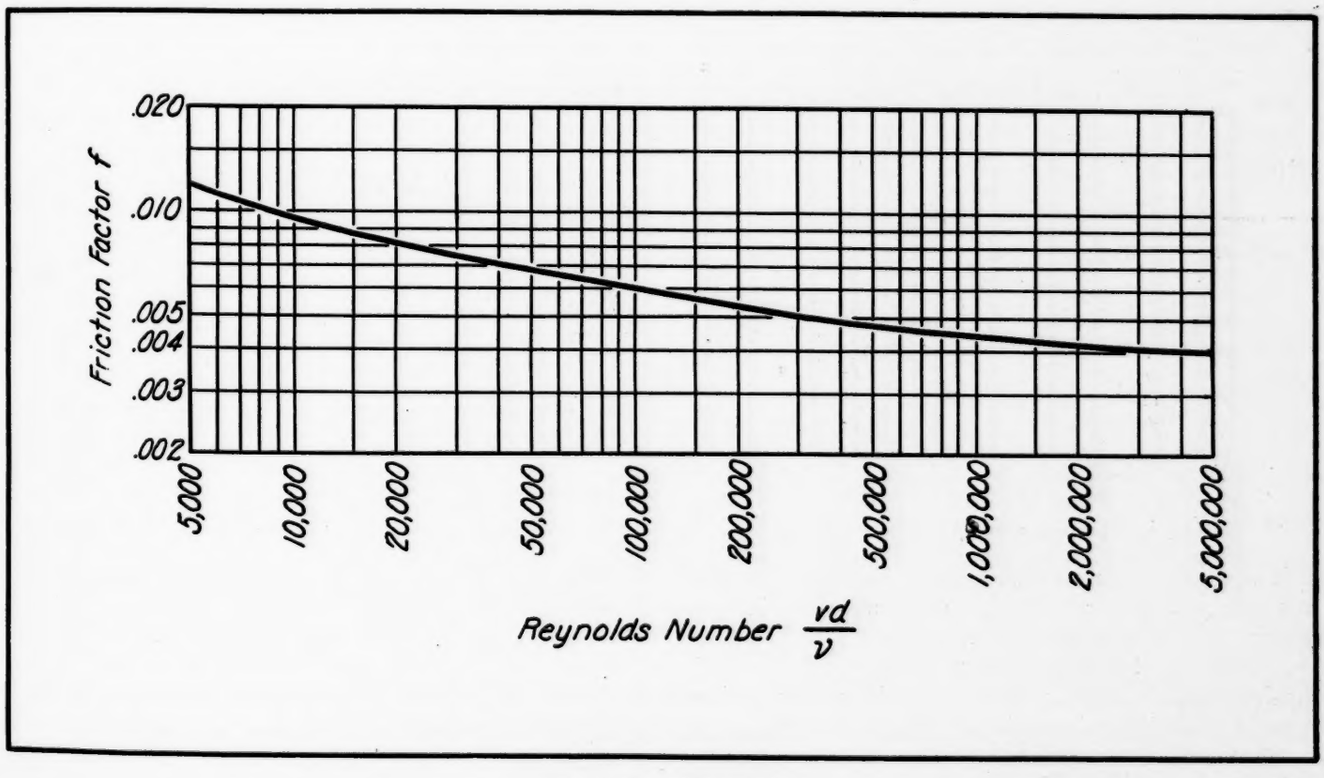


Fig. 6. Friction factor.

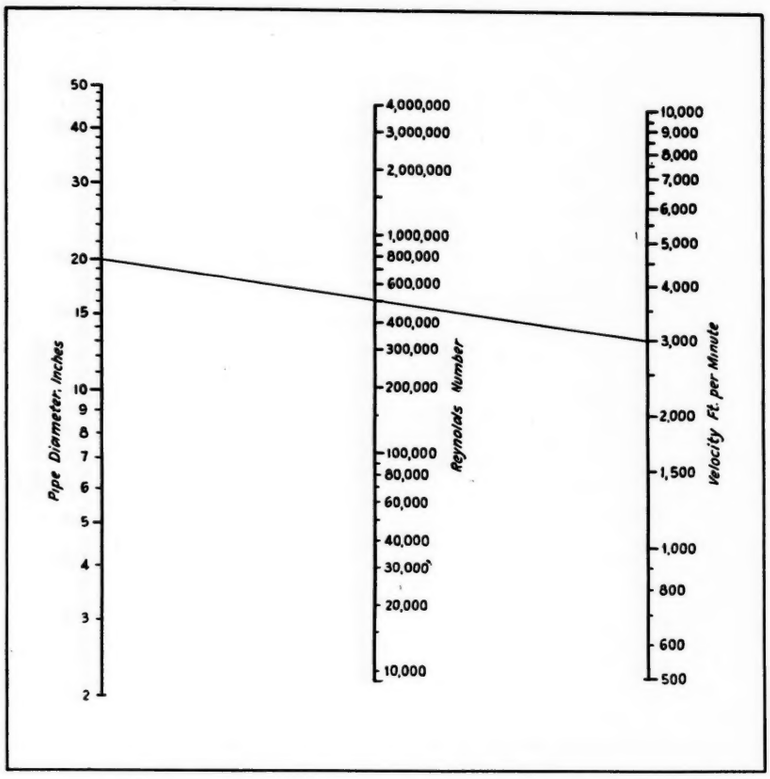


Fig. 7. Chart for calculation of Reynolds Number.

limit of the unstable zone is close to R = 3000. Above R = 3000 the flow is always turbulent; below 1160 always laminar and between, it may be either.

Flow Always Turbulent in Exhaust Systems

The most frequent range of Reynolds numbers in exhaust systems is from 100,000 to 1,000,000. An exceptionally low value would be R = 30,000 which corresponds to 2-in. diameter pipe at 2000 f.p.m. It is evident that only turbulent flow is present in any exhaust pipe. The brief table of critical velocities for various pipe sizes, Table 1, shows that laminar flow is impossible under operating exhaust conditions.

TABLE 1—CRITICAL VELOCITIES FOR AIR, R = 3000

Pipe Diameter, in.	Critical Velocity, f.p.m.
3	120
6	60
12	30
24	15
36	10

Pipe Friction in Laminar and Turbulent States

It had long been observed that the frictional resistance obeyed two apparently different laws in the laminar and turbulent states. More recently it has been established that the dimensional formula is valid for both states of flow. In the laminar flow region $f = 64/R$ and the dimensional formula becomes

$$\Delta p = \frac{32\mu l v}{g d^2}$$

which is Poiseuille's law for the resistance to viscous flow.

The friction factor, f, for turbulent flow through sheet metal pipes is plotted against Reynolds number in Fig. 6. The alignment chart, Fig. 7, permits quick graphical calculations of R for standard air. If the temperature, humidity and pressure conditions are greatly different from those defining standard air it may pay to compute a special value of R for the expected conditions. The principal influence of these variables is on the density. Viscosity is affected only moderately by the temperature and practically not at all by the humidity and pressure. Hence, R can be adjusted upward or downward in proportion to the change in density. In nearly all cases, however, values for standard air are entirely satisfactory as a basis for the Reynolds number and friction factor. Later in this series a logarithmic friction loss chart will be presented covering practically all exhaust needs.

Velocity Distribution

The rate of flow of air through a pipe is greatest near the axis and least near the wall. Even in turbulent flow, the boundary layer next to the wall is practically at rest for a distance at least equal to molecular thickness. Fig. 8 represents a longitudinal section through the axis of a long, straight, cylindrical pipe. The velocities at various radial distances from the axis are represented in magnitude by the length of the arrows indicating the direction of flow. For streamline flow a curve drawn through the tips of the arrows is parabolic in shape. When the flow is turbulent, the velocity profile is substantially parabolic from the axis to a point about 8/10 of the radius outward from the center line. From there to the pipe wall the shape of the profile varies with the Reynolds number.

Occasionally it is necessary to obtain the mean velocity from a single Pitot tube measurement on the centerline of the pipe. If the approach to the Pitot station is long and straight, normal velocity distribution similar to Fig. 8 will prevail. The ratio of the mean velocity to the centerline velocity has been plotted

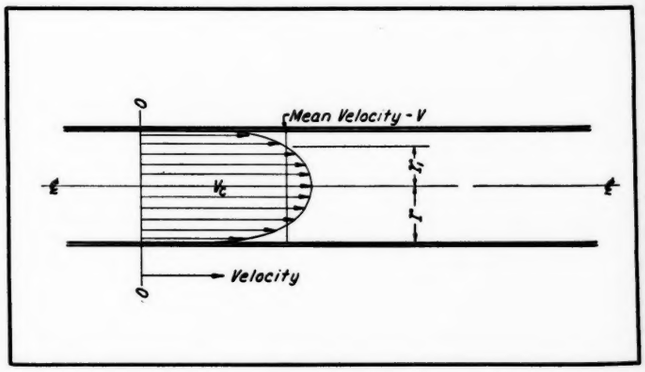


Fig. 8. Velocity distribution in straight pipe.

against the Reynolds number in Fig. 9. This curve is useful if upstream disturbances have not upset the velocity distribution. It will be observed the $V/V_c =$ 0.5 and is constant at all Reynolds numbers below the critical. This is the theoretical value in the region of laminar flow. At high Reynolds numbers the curve flattens and appears to attain a constant level of about 0.82 above R = 100,000.

It is possible to find, experimentally, a point in the cross section of a pipe where a single Pitot tube reading will be that of the mean velocity. If the velocity profile is symmetrical and otherwise normal a Pitot tube located between 7/10 and 8/10 of the radius outward from the pipe axis will give mean velocity pressure readings. In Fig. 8, r_1 is such a location since it represents the radial distance to the intersection of the velocity profile and the line of mean velocity. r_1/r, like V/V_c, depends upon the Reynolds number although the relationship is not so well established. If the mean velocity must be found from a single reading, it is better to take that reading at the centerline of the pipe and apply Fig. 9 than to attempt to locate the exact point on the velocity curve where the line of mean velocity crosses.

Actual velocity profiles may depart considerably from those just described. Stanton and Pannell used straight runs of pipe from 90 to 140 diameters long in approaching the plane at which data for Fig. 9 were taken. It is probable that the curve is not valid for approaches shorter than 40 to 50 diameters of straight pipe.

Flow of Mixtures

A homogeneous fluid has been assumed in the preceding discussions. In practice the fluid flowing in an exhaust system is a mixture of air and suspended dust or even coarser solids such as grain, sawdust and heavy chemicals. In most instances the solids flowing in dust collecting systems are a very minor influence on the friction loss and power. In heavy concentrations, however, the solids affect friction materially.

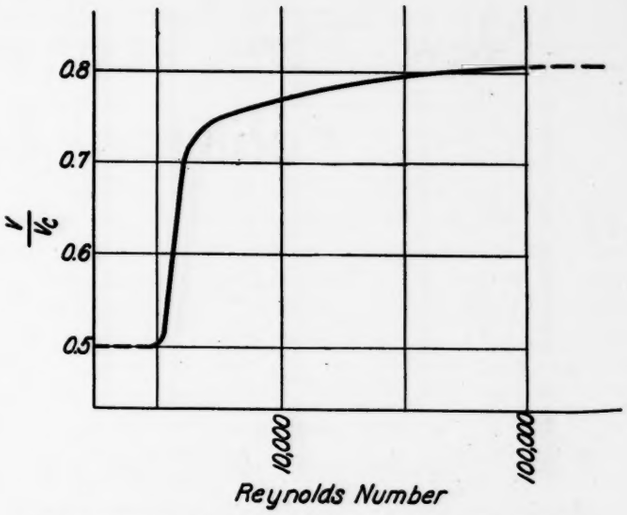


Fig. 9. Ratio of mean velocity to center line velocity.

The weight and volume of dust per cubic foot of air is very small in ordinary dust control systems. In dry grinding, for example, it is rare that less than 10,000 cu. ft. of air is handled per pound of mixed abrasive and metallic dust. The dust thus comprises not more than ⅛ of 1% by weight of the mixture. By volume, the dust does not exceed 1/20,000 of 1%. Intermittent tool grinding often produces a concentration of less than 1 lb. of dust per 100,000 cu. ft. or less than 1 lb. of solids per 7500 lb. of air.

At the other extreme is the relief fan of a heavily loaded wood working system. Such a fan may convey a pound of solids on as little as 100 cu. ft. of air. Even so, the concentration by weight is but 1 lb. of wood waste to 7.5 lb. of air, and by volume, 1 cu. ft. of solids to 4000 to 6000 cu. ft. of air. From these limiting examples it is evident that the presence of solids may generally be ignored in the design of dust collecting systems. This is borne out by many friction loss measurements made on actual systems when handling clean air and when dust is flowing.

Will Air Conditioning Cabinets Follow Radio's Bad Example?

HAVING survived thus far, albeit somewhat groggily, the bad design prevalent in most radio cabinets, the punished public will soon have to accommodate itself to another modern gadget, the air conditioning cabinet. That part of it which is at all sensitive to design is wondering whether the monstrosities of the radio cabinets are to be repeated or whether the makers of coolness will have a little better æsthetic sense than the makers of sound did.

It has been asked in all seriousness whether or not there has been a conspiracy to keep good radio cabinets off the market. Certainly the buyer of a radio who wants a good cabinet is forced to do a lot of shopping before he can find one even approaching good design.

Both radio and air conditioning are distinctly products of this age, and it seems a little incongruous after all to mention them along with Chippendale and Sheraton furniture. It is entirely possible, however, to design a radio cabinet and an air conditioning cabinet which will harmonize with the spirit of the times and yet which will not be incongruous when placed alongside traditional furniture.

The secret lies in simplicity of line and in good proportion. Is there a radio cabinet on the market which consists of a mahogany box with rounded corners, no ornament, good grain in the wood and a rubbed finish? If so, I could not find it when I was hunting for a radio not long ago.

I really think, though, that the air conditioning people will have better taste than the radio makers. I have seen a few cabinets illustrated, and about half of these were well designed. There was no effort to put one of these machines into a traditional case. The design of the good ones, however, was such as would harmonize with any kind of furniture.—*Charles Messer Stow in the New York Sun.*

New York Contractors Operate Under Voluntary Fair Trade Rules

EARLY this year a voluntary code of fair competition for heating, piping, and air conditioning contracting in the city of New York and adjacent counties on Long Island went into effect. This code purports to establish fair trade regulations for the trade and eliminate practices which have resulted in lowering wage scales, wage kickbacks, and use of improper substitutes for standard or specified materials. A somewhat similar voluntary code is in operation in Chicago and others have been proposed elsewhere.

These codes are of interest to the industry generally inasmuch as they apparently reflect a trend in agreements between contractors and labor. Consequently, excerpts from the New York voluntary code are printed here. The code is a result of bonafide collective bargaining between employers and employes.

The code defines a heating, piping and air conditioning contractor as any person, firm or corporation who furnishes and/or installs systems or parts thereof for steam heating, hot water heating, ventilating, refrigeration, air conditioning, automatic sprinkler equipment and piping for fire protection purposes, power piping, industrial process piping, pneumatic piping, hydraulic power piping, gasoline piping, gas piping except when used for culinary or illuminating purposes, high and low pressure boilers, stokers, oil burning units, and all apparatus, appurtenances and piping systems in connection therewith regardless of whether such piping conveys steam, water, air, brine, ammonia, oil, gasoline, gas or other fluids or other commercial products manufactured or in the course of manufacture.

The code is an agreement between the Heating, Piping & Air Conditioning Contractors New York City Association, referred to in the code as the Employers Association, and two labor groups—Enterprise Association Local Union 638 and Progress Association Local Union 639, both of the United Association of Plumbers and Steamfitters of the United States and Canada. The Employers Association will admit to membership any reputable contractor engaged in heating, piping and air conditioning work who agrees to observe enforcement of and adherence to the wage scale and regulations set up in the code. On their part, the labor organizations agree that their members will work only for contractors who subscribe to and observe the requirements of the code. Independent contractors, not members of the Employers Association, can secure labor from the unions provided they comply with the requirements of the code. The code, now in effect, will continue in effect until June 30, 1939, subject to modifications.

Wages and Hours

From July 1, 1937 to June 30, 1939 regular time for steamfitters shall be paid for at $13.20 per 8-hr. day and $9.90 for helpers. Fractions of days are to be paid for at the same rate. Work done between 5 p.m. and 8 a.m. on weekdays, that done on Saturdays, Sundays, and a number of holidays which are enumerated in the code, time will be paid for at double the regular time rate. Fitters and helpers will be paid at quitting time on Friday for the week ending the Wednesday of the week prior.

Scope of Steamfitting

Following is a list of work which according to the code comes under the province of the steamfitter and the steamfitter's employer.

"Whenever any apparatus, utensil or appurtenance erected or installed by the steamfitter shall require a connection from the water supply of the building, or from any piping erected by the plumber, such supply or waste connection shall be made by the steamfitter. The plumber shall leave in the water supply piping and in the waste or sewer piping, suitable outlets, at practical and convenient points, and the steamfitter shall run all necessary piping from such outlets to the apparatus erected or installed by him and from such apparatus to such outlets.

"Piping of every description, together with its accompanying fittings, valves and appurtenances (excepting, only, air piping for thermostatic valves) which joins together the several parts of apparatus erected or installed by the steamfitter, in accordance with the jurisdiction of a steamfitter as herein described, including bypasses, shall be erected, installed and connected by the steamfitter, and this regardless of whether such piping conveys steam, water, air, brine, ammonia, oil or other liquids or any commercial product or any product in course of manufacture.

"All steam, pneumatic and hydraulic power piping other than the piping for thermostatic valves.

"All steam and hot water heating apparatus and all steam boilers connected to hot water tanks.

"All heat regulating systems, excepting piping for thermostatic valves.

"All vacuum heating systems are the work of the steamfitter. All vacuum cleaning systems are the work of the plumber, provided, however, that same does not include any form of piping for cleaning electrical and other apparatus and machinery as provided for in paragraph No. 10.

"All pneumatic tube systems.

"All ice-making, refrigerating and cooling apparatus of every description. This does not include piping for transmitting ice water for drinking purposes.

"All hydraulic piping for elevators, and for the operation of curtains, presses and machinery.

"All oil piping in connection with power or heating apparatus, provided, however, that piping used for the transmission of liquid gasoline in garages, dye houses and cleaning establishments shall be the work of the plumber.

"All air piping for power work, cleaning of electrical and other apparatus and machinery.

"Placing, erecting and testing of all fan coils, humidifiers and air washers in connection with heating and ventilating and connecting together the parts thereof.

"Setting of all fixtures, pumps, tanks and heaters in connection with steam power apparatus or with steam or hot water heating apparatus.

"All steam connections for hot water tanks shall be the work of the steamfitter. The employees of the contractor furnishing the tank shall place it with all necessary hangers or supports and the plumber shall make all water connections to the tank.

"Hot water tanks and heaters for domestic purposes, which have no steam connections, shall be installed by the plumber.

"All air piping for window or door opening devices or for switch or signal systems or for like purposes.

"Building and repairing of water grates for power or heating.

"All sprinkler systems including all fire standpipes connected thereto shall be installed, complete, by the steamfitter, excepting, only, that the plumber shall set the meter and do all piping from the meter to the water supply main in the street.

"All fire standpipes not connected with the sprinkler system, nor with the water supply of the sprinkler system, shall be the work of the plumber.

"All steam and return connections of all kitchen utensils.

"All steam ejectors and all piping in connection therewith.

"All piping for the transmission of glucose, syrup, liquid sugar, ink or other liquids in manufacturing or commercial plants or for the transmission of such other commodities as pass through piping from one point to another in manufacturing or commercial plants, when such liquids or commodities are part of the product of such plants, and all piping utilized for railings and racks and similar pipings shall be the work of either the steamfitter or plumber, provided, however, that pipe railings in engine rooms and boiler rooms shall be the work of the steamfitter."

In all matters as to which decisions have, heretofore, been rendered by the Arbitration Board of the New York Building Trades, such decisions shall govern the jurisdiction of the plumber and steamfitter.

Bids and Materials

No bid or contract for the installation of heating, piping, ventilating, or air conditioning shall be combined with any bid or contract for any other work whatsoever except that enumerated under scope of steamfitting and the submission or making of any combined bid or contract will constitute a violation of the code.

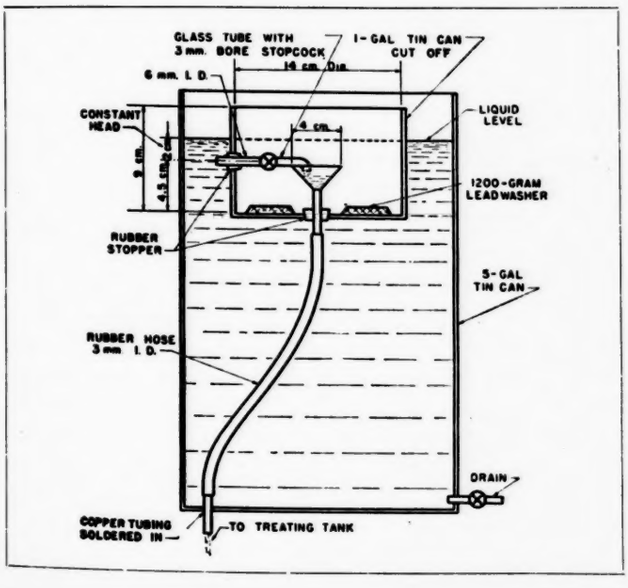
Rules of Practice

Among the rules of practice to be observed by employers signing the code are the following: No employer shall accept either directly or indirectly any rebate on wages, nor shall he make any secret agreement with any awarding authority concerning terms of payment, rebate or special conditions not included in the original bid.

Each bid submitted shall be a final bid. If a system is designed by an architect or engineer and the specifications require the contractor to assume responsibility for and guarantee that the pipe sizes and apparatus are all adequate sizes and capacity, it will be considered an unfair practice and a violation of the code for any contractor signing the code to assume such responsibility or make such a guarantee.

In bidding on any job each employer shall add to the total cost of material and job expense an item of not less than 15% for overhead and to this is to be added a profit of not less than 6%.

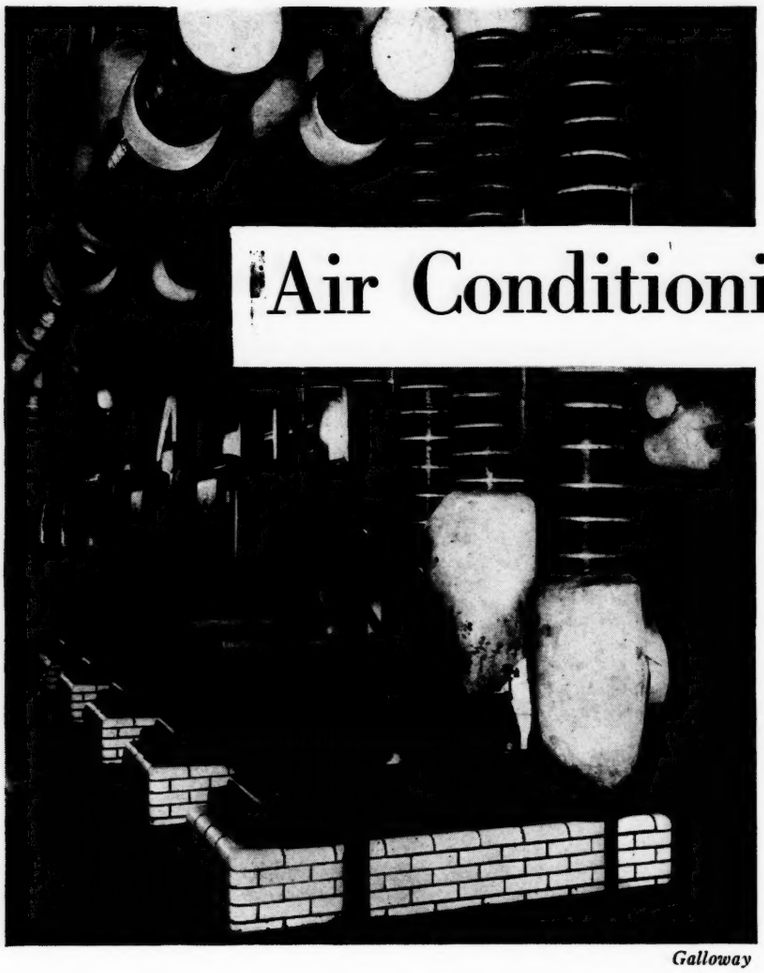
The code sets up an elaborate system of investigating violations of and enforcing its rules providing for censuring, fining or suspending all those accused. Fines will be imposed as follows: For failure to pay the wage scale a fine not to exceed 10 times the total amount of the deficiency. For violation of any rule or practice a fine not exceeding $200; for violation of any other provision, a fine of $200 for the first offense and not exceeding $500 for each succeeding offense.



Feeding Device for Boiler Compound

THE feeding device illustrated is for adding boiler compound at steady rates to boiler feed water. It was described by J. L. Smith in a recent issue of Industrial and Engineering Chemistry. It maintains a constant head and constant rate by floating the intake end of the delivery tube. It is simple in construction and the necessary materials should be found in any laboratory.

A 20-liter (5-gallon) and a 4-liter (1-gallon) tin can, a small glass funnel, copper tubing, a glass stopcock, rubber stoppers, scrap lead, small-bore rubber tubing, and a piece of glass tubing are all the materials needed. The device as illustrated will deliver from 20 to 180 ml. per minute at constant rate. Higher or lower rates may be obtained by varying the ballast in the float to vary the head, or by using tubing and stopcock of larger or smaller bore.



Electric Motors *for* Air Conditioning Applications

Galloway

By J. A. RODGERS†

Selection of the proper electric motor for driving a fan or compressor is a frequent problem of the air conditioning contractor and engineer. The accompanying article will be of great assistance in solving such problems. Among the subjects discussed are application of motors to air moving and gas compression equipment, characteristics of various types of motors, changes in power requirements with changes in fan speeds, radio interference, cycling of refrigeration compressors and motor production. The article was abstracted from a paper presented in Cleveland at the mid-year convention of the National Warm Air Heating & Air Conditioning Association

THE applications of motors in the warm air heating and air conditioning field are broadly divided into two major groups.

The first classification applies to motors required to operate automatic water, gas, or steam valves, various types of air dampers, clock mechanisms for timing purposes, etc. As this type of motor is usually supplied with the device and purchased as an integral single unit, the specific type of motor required for the application is not a matter of importance to this group and will, therefore, be omitted from any further discussion.

The second type of applications, namely, the motion and compression of gases, should be sub-divided into two classes: (1) the motor application to fans, blowers, and similar air-moving equipment, and (2) motor application to compression equipment as would be required for gas compression for refrigeration purposes.

Let us consider the first sub-classification, namely, motor application to fans, blowers and similar air-moving equipment. Generally speaking, this is one of the most simple and ideal types of motor application, as, if proper original recommendations are made regarding motor rating, it is practically impossible to overload the motor either during starting or running condition. In all types of disk fan or other similar propeller fans, it is common practice to apply a motor the rating of which is adequate to handle the fan under free air conditions. While a very slight increase in motor load may occur in this type of fan, due to the addition of static pressure, the increase is so slight as to be well within the normal performance of almost any motor properly specified. For this reason this type of application seldom results in motor failure, with the possible exception of the detrimental effect of the fan thrust on the motor bearings. The one sure way of overcoming this objection is by the use of a special thrust assembly to insure proper thrust area and thrust design.

The second type of air-moving application, namely, the centrifugal blower field, presents slightly more complicated problems in motor application due to the fact that a wide variation in motor load results from variation in static pressure on the blower. The safest method of applying a motor is the specification of sufficient power output from the motor to handle the blower at free air delivery; that is, at zero static pressure. This, of course, will in some instances require a motor rating larger than necessary in the case of a blower performing under a specific static, the value of which will never decrease. If such information regarding the static pressure is known and well fixed, the use of a lower motor rating is recommended, but in any instance should be rechecked when the job is completed

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and installed, so as to be sure that no errors have occurred in the original calculation, resulting in motor overloads.

One feature distinguishing the motor application in this field is its comparatively low starting torque. There is practically no other field of motor application where the torque required for starting is, in effect, little more than overcoming the bearing friction, as is the case in the air-moving fan and blower field above discussed. For this reason and for the reason of comparatively low overload requirements, proper motor design should result in comparatively low starting currents and high motor efficiencies in all cases. This is particularly fortunate in view of the long continuous operating periods and frequent starting requirements involved in this type of service.

Motors Available

The simplest and most inexpensive type of motor for this application is what is known as the splitphase or resistance splitphase type, of which the standard washing machine motor is the least expensive. Due to this fact there has been a trend in the field to use this motor in a great many cases. This is unfortunate, in that such a motor is poorly suited to the application due to its extremely high starting current, its high noise level, and its construction primarily designed for extremely high torque and intermittent service of the washing machine type. In fact, in design this motor is in the majority of respects contrary to those requirements previously specified as desirable in this field. It is, in my opinion, a most serious error to employ a motor of these characteristics for use in a piece of equipment where quietness of operation, long periods of continuous duty, and entire freedom from line disturbances resulting from high starting currents are of paramount importance.

There are other types of splitphase motors, however, which are properly designed for this particular type of service and are designated as "fan duty" motors. These motors have a blocked or stalled current not in excess of 20 amperes, obviating serious line disturbances and light flicker during repeated starting; a mechanical construction entirely adequate for continuous duty over long periods without frequent relubrication, and a sound factor well within the limitations required for application in a warm air or other similar systems involving ductwork or piping. This type of motor has been known in the field variously as the long hour or long service motor, but is, in effect, the standard line of fan duty motors produced by most of the industry. This motor also has the advantage of production in both single speed and two speed types, both types being applicable to air-moving equipment of either the direct-drive or belted design. There have been at various times attempts on the part of motor manufacturers to produce a motor having more than two speeds, in the splitphase type, but due to the complication of leads and inter-connecting switches, these attempts have in the majority of instances been abandoned. So today the splitphase motor of the long hour, fan duty specifications constitutes single and two speed types of most satisfactory design for this service.

Capacitor Motor

Another group of motors applicable to air-moving equipment is the capacitor or condenser motor group. There are two specific types of capacitor motors. One is known as the high torque capacitor motor and is essentially a single speed motor. The other, a low torque capacitor type, is suitable for either single or multispeed operation, depending upon its design. The use of the high torque capacitor motor, while confined to single speed performance, is generally necessary where a belt or similar type of drive is used in order to insure adequate starting torque. Where it is possible to mount the fan or blower assembly directly on the motor shaft, eliminating all belts or similar type of driving mechanism, the ideal motor of all types is unquestionably the low torque capacitor. This motor is the most flexible in characteristics of any known type in the field. While its starting torque is extremely low, in the majority of instances less than that developed at full load, it is nevertheless adequate for all direct applications of air-moving equipment, as previously outlined. Further, due to its entire elimination of all moving contacts and its susceptibility to speed control, it offers a maximum of flexibility in air-moving applications.

Speed control in this type of motor can be accomplished in two ways: first, by the use of a series resistor, adjustable to as many ranges as desired, and, second, by means of a transformer capable of reducing the line voltage to the motor. By far the more desirable is the transformer control. Particularly is this so if voltage reduction is supplied only to line circuit winding, allowing the capacitor circuit windings to remain at normal voltage so as to maintain a maximum starting torque at the lower speeds. In addition to the ideal performance obtainable with such a motor, there is also the simplicity of the switching problem, resulting in simplification of controls.

Motors of this type are readily available to the fan and blower manufacturer and, in summing up their advantages, offer opportunities for multispeed operation, minimum noise level, maximum motor efficiency, and, in the majority of instances, practically unity power factor to the designer who will incorporate a direct motor drive in his application.

Shaded Pole Motor

One remaining type of motor used in certain fan and blower applications, particularly in ratings of 1/30 hp. and less, is the shaded pole motor. This type has torque characteristics similar to the low torque condenser motor, but is markedly less efficient in performance. In view of the comparatively low horsepower ratings for all motors of this type, this low efficiency is not serious. As previously stated, this motor is applicable only in a very limited field, one probably not encountered by this group.

All of the above discussion has been on single phase a.c. motor application to the fan and blower field. While this constitutes, by far, the major portion of the problem, there are also some few polyphase and direct current motors used in this field. Therefore, a rather limited discussion will be given regarding their char-

acteristics. The first consideration will be the polyphase companion type to the single phase motors above discussed.

As the majority of sizes will be ½ hp. and less, the occasion for the use of a polyphase motor by choice, with the exception of large installations, is rather unlikely. Of course, the polyphase motor has its distinct advantages in that it is free from all types of moving contacts either during the starting or running period, but the additional wiring involved, as well as the necessity for the manufacture of special motors for the application, generally offsets to a large extent the otherwise ideal application of the polyphase type. It is possible, however, to obtain polphase motors in sizes all the way from ⅛ hp. upward, provided special orders are placed with the motor manufacturer. It is also possible to obtain the same type of speed regulation as has been described for the low torque condenser motor. Therefore, the polyphase motor is in every respect interchangeable with the single phase low torque condenser type, but holds very little advantage over this type, particularly in view of the more complicated wiring previously mentioned. Where motor sizes in excess of ½ hp. are required, some distinct advantages exist in favor of the polyphase type, and if the polyphase line is available, this motor is to be recommended. One matter of importance should be mentioned in connection with this polyphase motor and that is, the insurance that all motor lines are adequately fused and are inspected at such regular intervals as are necessary to insure against the overheating and failure of one phase. The result of such a failure is the single-phasing of the motor, resulting in its failure to start and ultimate destruction. More difficulties are encountered through this feature than an other item in polyphase application.

Direct Current Motors

The direct current motors for this service range all the way from the straight shunt to the compound types, depending upon size. Generally speaking, a motor up to and including 1/6 hp. may be shunt wound. Above this rating a compound winding is recommended. Speed control can, of course, be obtained through practically unlimited ranges, through the use of field or armature resistance type controls. Therefore, the application in the direct current field is not limited as in the case of the single phase alternating current. The torque of the d.c. motor is also markedly higher than in the case of the average low torque a.c. types. Therefore, this problem is eliminated. Generally speaking, the only serious factor connected with the use of the direct current motor is the maintenance required as a result of the commutator and brush assembly. There is also the problem of suppressing radio interference, but if properly specified by the manufacturer, this suppression can be incorporated as an integral part of the motor.

Motors for Compressors

In the case of the fan and blower field, the starting torques required to bring the apparatus in motion were extremely low. The requirements in the compressor field are quite to the contrary. Here, in the first revolution of the apparatus the motor is often required to produce torques far in excess of that necessary to keep the equipment in constant motion. For this reason what is known as a high torque motor is necessary. Generally speaking, such a motor will show a starting torque of from three to five times its full-load rating.

In this classification for single phase a.c. requirements fall the repulsion start induction motor, the capacitor start induction run motor, and various types of high torque capacitor start capacitor run motors. Each of these various motors has a distinct place in the field, depending largely upon the sizes or ratings required. For ratings up to and including ¼ hp., the capacitor start induction run motor is quite well accepted as the ideal motor for modern application. This size and type is used throughout the entire domestic refrigeration field. For sizes ¼ to ½ hp. there have been some capacitor start capacitor run types used, as well as the repulsion induction type. For ratings above the ½ hp. and up to and including 5 hp., the repulsion induction motor still remains the choice, due primarily to the bulky size of the capacitor necessary for the capacitor type motors in sizes of these ratings.

As the interest of this group is largely associated with air conditioning or space cooling, and as the motor ratings for this type of service will range from ½ hp. upward, the discussion will be confined to motors in these sizes. As previously stated, the repulsion induction motor for these ratings has remained for many years the preference. Therefore, it is recommended that for sizes ½ hp. to and including 5 hp., this type of motor be used unless for some specific reason, as is the case in a certain limited number of room coolers and similar type of equipment, the capacitor motor can be more advantageously applied. In motor ratings above 5 hp., practically no choice exists for a.c. application excepting the polyphase motor and, in fact, this type of motor is to be desired where this power is available and where economical rate combinations can be obtained. Unfortunately, particularly in the domestic field, the use of polyphase is extremely limited and necessitates a double rate; that is, one rate for the lighting load and one for the power load, which practically obviates the use of the very desirable polyphase motor for cooling applications.

In the case of the direct current application, the compound motor is, of course, recommended throughout, and in the majority of instances in ratings over 1 hp., a special magnetic starting switch is necessary. This should consist of a one or two step magnetic resistence starter so as to reduce the line surge resulting from across the line starting. Other than this the direct current motor will perform adequately in this service. Here again the maintenance involved is materially greater than in the case of a polyphase motor, and similar to that required for the single phase repulsion induction. Therefore, if possible, the polyphase type should be substituted where the power is available.

Having completed in a rather broad manner the general types of motor applications in this field, as well as the specific types of motors recommended, it would probably be of interest to discuss briefly some

of the problems which are involved in the various types of motor application, particularly those problems which should be given consideration during or prior to the motor recommendation. As previously organized, the discussion will first consider the problems in the fan and blower or air-moving field.

One of the most serious problems herein encountered is that resulting from the blower manufacturer supplying a motor complete with a multi-step pulley, or, what is worse, with a recommendation that for change in air delivery, a different pulley and belt combination may be supplied. The general result of this is that if the installer, after completing the application, finds insufficient air delivery, he is likely to go to some supplier, get a new belt and pulley combination, or use one of the pulleys which were supplied and obtain a smaller or larger one for the other, thus raising the speed of his blower. He entirely overlooks the fact that the required input to the blower will increase as the third power or the cube of the speed; the result being that the motor is seriously overloaded, probably never gets off the starting winding and, of course, ultimately burns out. Undoubtedly the majority of engineers connected with this industry are thoroughly familiar with the marked increase in power resulting from the increase in speed, but I would urge every one to become thoroughly familiar with the rapid increase which results from such change in blower speeds, so as to be able to properly calculate the result of a speed change which he desires to make.

EFFECT OF CHANGE OF FAN SPEED ON POWER REQUIREMENTS

Decrease in Speed, Per Cent	Power Required, Per Cent	Increase in Speed, Per Cent	Power Required, Per Cent
0	100.0	0	100.0
10	72.9	10	133.1
20	51.2	20	172.8
30	34.3	30	219.7
40	21.6	40	274.4
50	12.5	50	337.5
60	6.4	60	409.6
70	2.7	70	491.3
80	0.8	80	583.2
90	0.1	90	685.9
100	0.0	100	800.0

The second problem which arises quite regularly is that of radio interference. In the majority of instances, radio interference is not caused by the motor on the blower or other type of air-moving equipment, but rather by some contact which has become corroded or is improperly seating. In fact, with the exception of the direct current motor, there is no type which will cause radio interference except during a very short starting period, and in the majority of instances this constitutes nothing more than a single click, such as may result from turning on a light switch. It is well, however, to understand this fact, so that in case of complaint, unnecessary labor may be saved in the investigation of the motor as a source of radio disturbance.

In the compressor field, by far the most serious problem is that of obtaining a sufficient number of starting cycles from the repulsion induction motor, particularly in the larger ratings, to satisfy the normal cycling periods occasioned by the average room thermostat. It is a fact that the well designed thermostat will attempt to maintain accuracy of room temperature control to within approximately 1F. Such accuracy of control is not only unnecessary, but results in frequent starting cycles and rapid deterioration of the brush and commutator assembly. The solution to this difficulty is the broadening of the differential on the room thermostat to approximately ± 2F, or the reduction in capacity of the unit so as to allow a longer operating period. Both of these solutions will, of course, jeopardize to some degree the accuracy of the temperature control, but no very satisfactory solution other than these has been found to prolong the cooling cycle and reduce frequent starting, which performance is essential to the life of the repulsion induction motor. Of course, in the case of polyphase or, to some degree, in the case of the direct current motor, frequent starts are of little importance.

The second problem involved in the field of air conditioning is really the result of the first; it is the failure of the repulsion induction motor to come to speed. This is occasioned by worn brushes or dirty commutator, and proper attention to this detail will not only insure longer life, but will provide against the constant operation of the motor on its repulsion cycle, which will result in very rapid failure of the equipment.

Motor Protection

There has been recently placed on the market by a number of motor manufacturers, various types of motor protectors built in as an integral part of the motor and actuated by the temperature of the motor. There are a number of applications where such protection is desirable, particularly in the refrigeration field. Here, motor overloads are a normal part of every cycle of operation, but they should not continue for a period in excess of that for which the motor was originally designed. Obviously, in case of failure of certain parts of the apparatus, continuation of the overload may result. Against such conditions the motor protector is an ideal device. In the case, however, of the application of a motor to a fan load, particularly the disk type fan, the use of a motor protector is superfluous, as in no conceivable manner could the load be increased to result in overheating. It would be useful only during the period of installation, where an error in connections or improper voltage connection might be made. In the case of the centrifugal blower field, a greater reason for motor protection exists, as, of course, motor overload is possible in this instance. It might be well to state that there are two types of motor protectors. One is known as the manual protector; the other the automatic. The manual protector does not automatically return the motor to the circuit, but merely opens the motor circuit in case of danger from overheating. The automatic protector returns the motor to the circuit as soon as the temperature of the motor frame reaches a predetermined safe value.

A Study of the Weather in Washington, D. C.

By MARY O. SOROKA

Too often the designing engineer is forced to base his calculations on sketchy information regarding the weather in the locality of the proposed building. Not only are figures relating to extreme conditions of concern to air conditioning engineers but such work requires in addition a detailed knowledge of the day-by-day weather and especially of the duration of maximum and minimum conditions. Unfortunately, such detailed studies prepared specifically for the use of air conditioning engineers are not often available. The accompanying article, based on data collected by the author and Robert B. P. Crawford, air conditioning engineer, Washington, D. C., does present information on weather in one large city in some detail, and this information is presented here with the hope that engineers having such data may be moved to publish similar information for other important cities.

THE basic data underlying a study for the control of indoor air conditions are the weather reports. A convenient way of analyzing the effect of wind, sun and rain on dry bulb, wet bulb and dewpoint is to plot simultaneous values on a single graph covering a 24-hr. period.

Obviously, the importance of the external load will vary with the type of building. For instance, in a residence, 90% of the total heat may be produced by out door conditions, whereas in a crowded restaurant the external load may be less than 50% of the total.

The readings used in the following discussion of Washington, D. C., weather are from the official U. S. Weather Bureau station at 24th and M Streets NW., an area which is fairly well built up. Although the studies utilize only the years 1928-1934, inclusive, and 1905 and 1906, in reality they represent an analysis of 30 years since the worst years for heat and humidity are in this group. The climatologist uses records of a slightly longer period, 35 years being considered the minimum. In this period a station may be considered to have experienced all the types of weather which are likely to occur.

Mean or average values tend to obscure those extremes of heat and cold which may have such disastrous effects. They create an illusion of steadiness and uniformity which is seldom justified by the facts. A picture of the variation in the day's weather is presented by the accompanying graphs.

For summer air conditioning problems, engineers are more concerned with values of wet bulb temperatures than those of dry bulb temperatures and unfortunately a record of the wet bulb for the 24-hr. period is not available for Washington or most other stations. In recent years, the relative humidity in Washington is given for every two hours. From these we are able to secure the wet bulb readings and the dewpoint. The relative humidity reading may not always give a true value for wet bulb but the wet bulbs derived from them are checked by comparison of the true wet bulb observation with the calculated.

The need for a thorough understanding of how weather varies is evident when it is found that there are years in which the readings of relative humidity were made only at the regulation hours of 8 a.m., noon, and 8 p.m. It is possible by a method of approximation to supply the missing data. Approximating the wet bulb directly is not expedient because the temperature of the wet bulb follows no definite laws. Almost anything can affect the wet bulb readings besides the actual temperature and humidity of the atmosphere. For example, the condition of the ground before and after a storm can have a slight effect.

Dewpoint, on the other hand, apparently follows definite trends. There are three variables which affect the dewpoint; namely: 1. *Wind*—velocity and direction; 2. *Rain*—temperature of precipitation, amount and duration; 3. *Sunshine.*

Wind velocity and direction affect the dewpoint rapidly. Velocity is important because it may control precipitation by the rate at which it brings up supplies of moisture. In general, the dewpoint increases with the wind but when the dewpoint is above 70F and the wind blows, the dewpoint drops. During a period of drought, a sudden rain storm will produce a jump in the dewpoint.

However, the influence of wind, rain and sun must be analyzed in the study of any of the variables and before continuing with the detailed view, some of the general facts will be presented. Winds are air currents and are responsible for our temperatures because they import and export the heat. They are also responsible for our rain. In Washington, the prevailing direction of the wind from May through September is south, the rest of the year it is northwest.

The amount of rainfall is dependent upon a variety of factors, such as the direction of the prevailing winds, the nature of the territory over which they have previously passed as to whether they are land or water areas. If land areas, it makes a difference whether they are low or mountainous and whether the surface character of the locality under investigation is high or low. In passing from colder to warmer regions, the air ex-

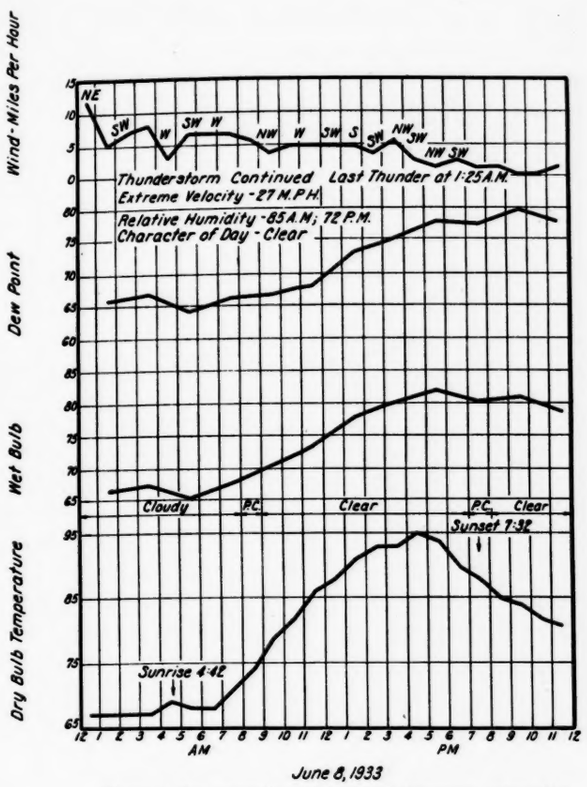


Figure 1 Day preceding the Day of Maximum Humidity

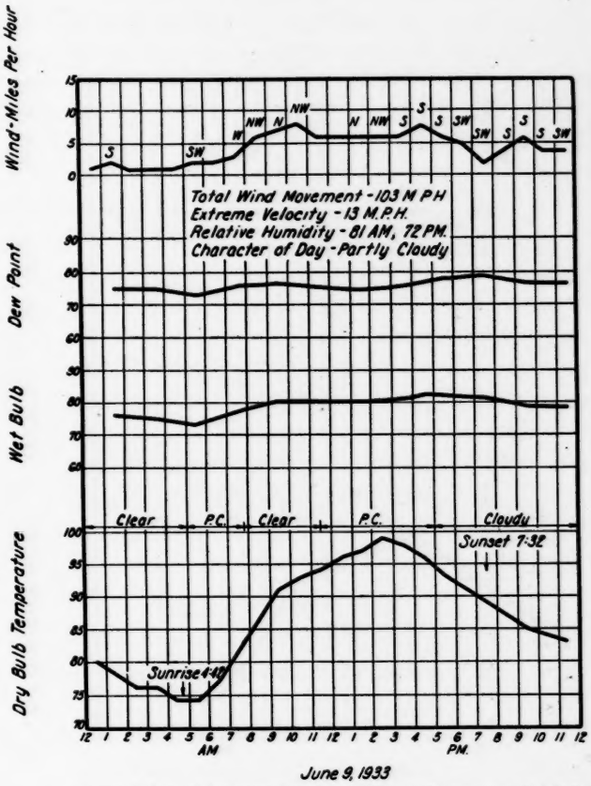


Figure 2. Day of Maximum Dew Point 79° and of Maximum Wet Bulb 82.5°

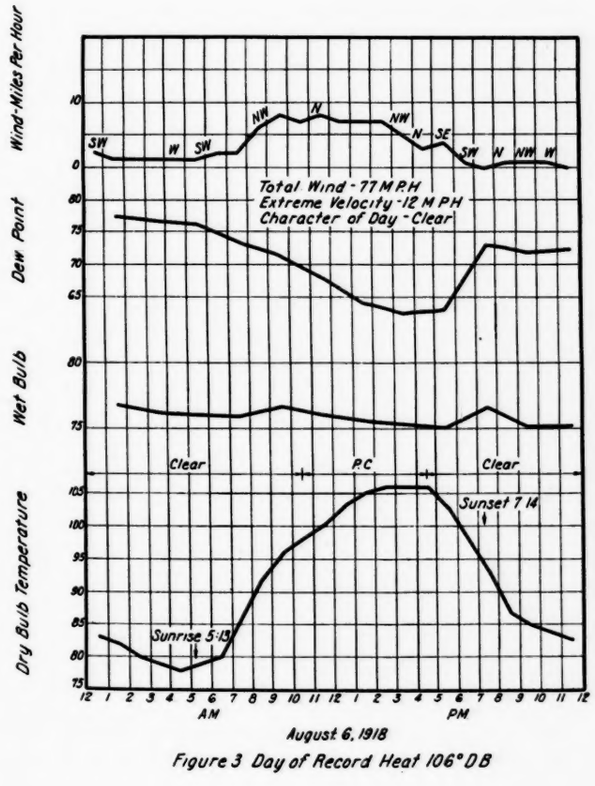


Figure 3 Day of Record Heat 106° D.B

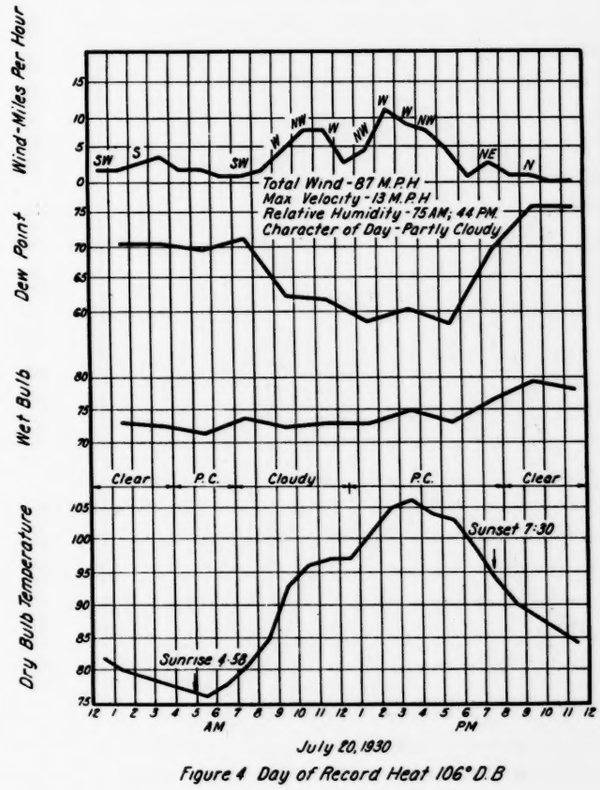
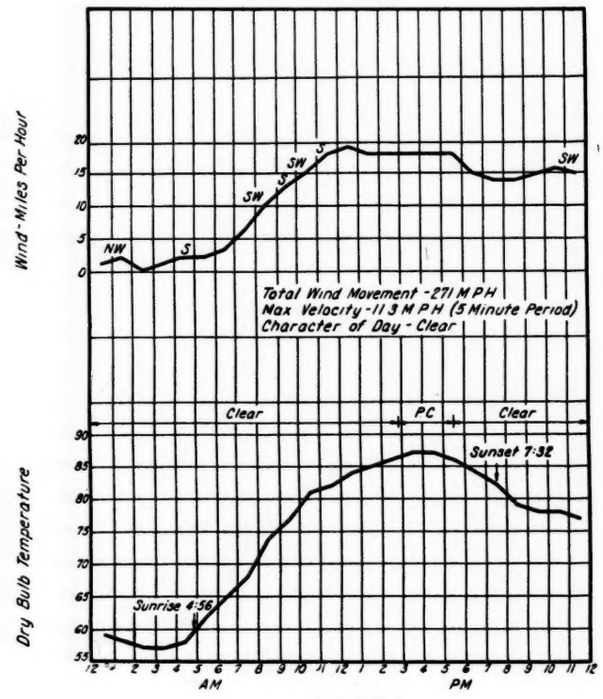
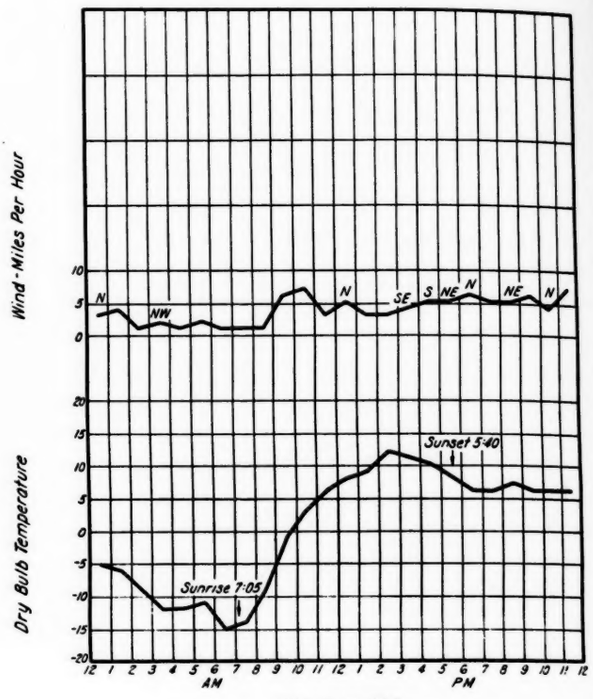


Figure 4 Day of Record Heat 106° D.B



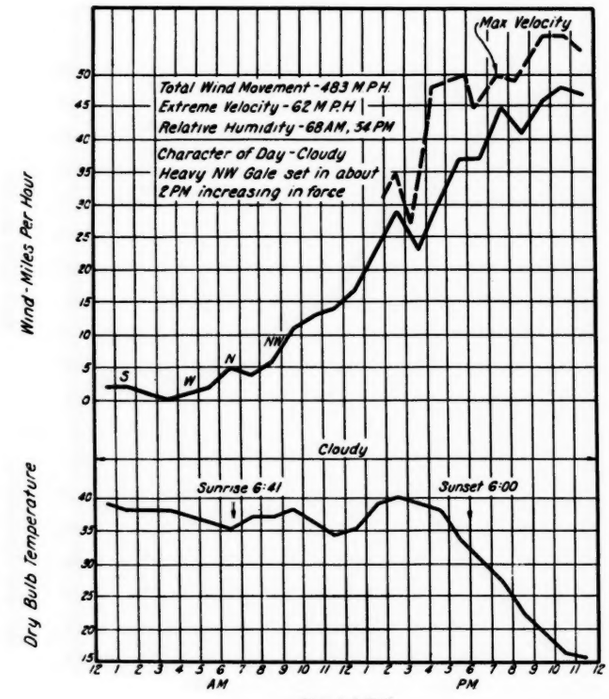
July 17, 1908

Figure 5 Day of Maximum Wind - Cooling Season



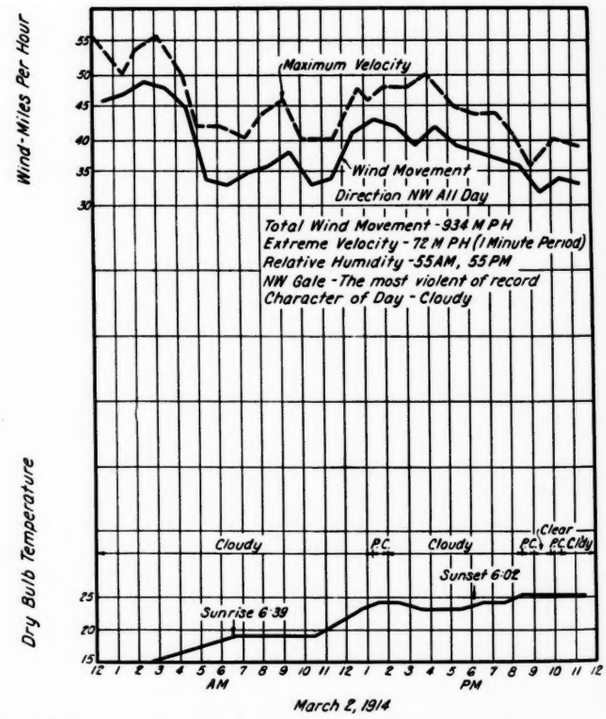
February 11, 1899

Figure 6 Day of Record Cold -15° D B


Wind - Miles Per Hour
Dry Bulb Temperature
Max Velocity
Total Wind Movement - 483 M P H
Extreme Velocity - 62 M P H
Relative Humidity - 68 AM, 34 PM
Character of Day - Cloudy
Heavy NW Gale set in about 2 PM increasing in force
Cloudy
Sunrise 6:41
Sunset 6:00
AM
PM

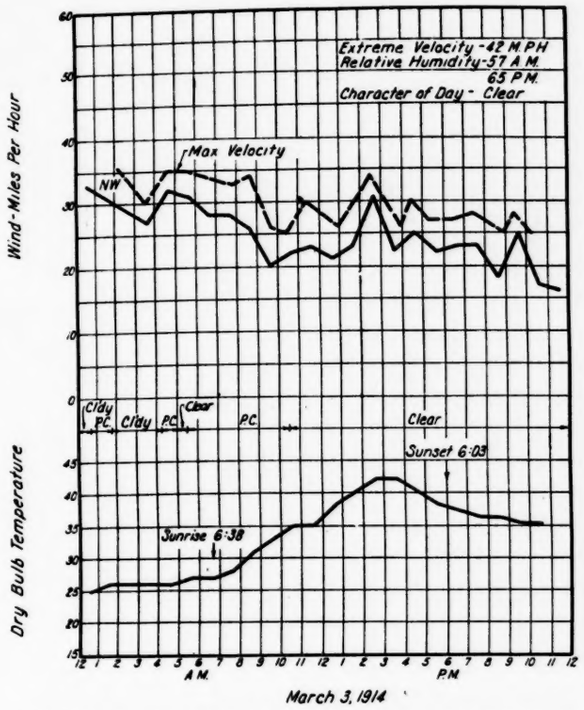
March 1, 1914

Figure 7: Day preceding the Day of Maximum Wind - Heating Season - Also see March 2, 1914



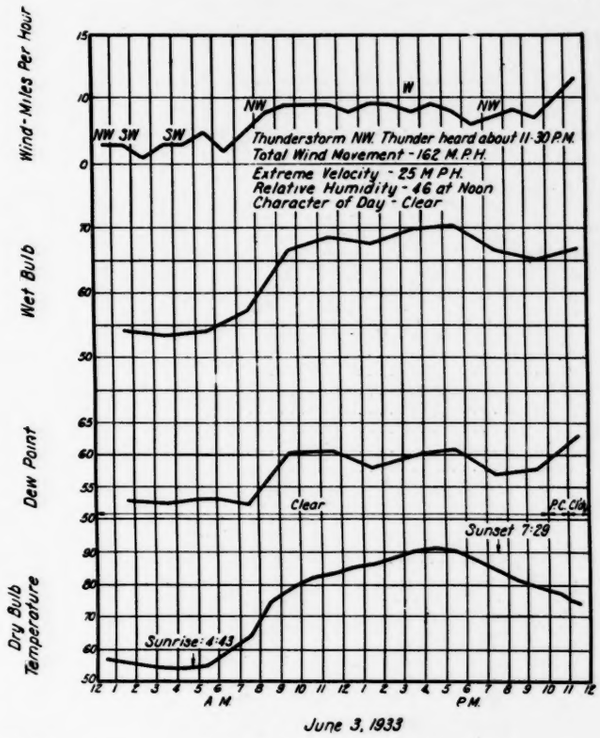
March 2, 1914

Figure 8 Day of Maximum Wind - Heating Season



March 3, 1914

Figure 9: Following the day of Maximum Wind-Heating Season - Also see March 2, 1914



June 3, 1933

Figure 10 Average Day - Sunshine 100%.

pands as its capacity to absorb moisture increases.

The number of hours of sunshine can be determined from the description of the character of the day, whether clear, cloudy, or partly cloudy for the hours between sunrise and sunset. A knowledge of the probable number of hours of sunshine for a given dry bulb temperature is one of the essentials in a study of weather. Tests have shown that sunshine through window glass is a most important factor to contend with in the cooling of an office structure and at times even amounts to as much as 75% of the total cooling necessary.

In order to trace the influence of the weather on dry bulb, wet bulb, and dewpoint, the following analysis of readings from hour to hour has been made for Fig. 1. The dewpoint was at a low point at 1:30 a.m., then the wind changed direction and a warm stream of air from the southwest came in at an increasing velocity which sent it up even though the dry bulb temperature remained constant. The dewpoint continued to rise until 3:30 when a sudden change in direction and decrease in velocity of the wind produced a similar decrease in the dewpoint. The decrease continued until a change in direction of the wind which came in from the southwest at an increased velocity.

At 7:30 a.m. the wind velocity decreased but the dry bulb temperature began to rise sharply and the dewpoint continued up with it. At 5:30 p.m. the wind came from the north and the velocity dropped; in addition the drop in the dry bulb temperature was beginning. These produced a slight decrease in the dewpoint until the effect of the southwest wind sent it up for a short period. The decreasing velocity of this southwest wind and the continued drop in the dry bulb then sent the dewpoint down finally.

There was no rain that day except the short thundershower after midnight. In general, the effect of rain is a fall in the dewpoint unless the rain is warm, in which case it has the opposite effect. Furthermore, if a short violent rain occurs when the ground has been baked dry and is hot, the rain will flash into steam and there will be a sudden and substantial increase in the dewpoint.

Figs. 1 to 8 have been prepared to show the conditions that produce extremes in weather. On June 9, 1933, Fig. 2, the maximum wet bulb of 82.5F (and also the maximum dewpoint) was reached. The curve for June 8, 1933, was included because it shows the development of the record values and because the wet bulb and dewpoint were extreme on that day also.

The maximum dry bulb temperature on record is 106F and this value was reached twice in 60 years. The dates were Aug. 6, 1918, and July 20, 1930, shown by Figs. 3 and 4. It is interesting to note that on both Aug. 6 and 7, 1918, the temperature remained above 100F for a number of hours with the extreme of 106F on the 6th and 104F on the 7th. The dry bulb temperature continued above 80F even during the greater part of two nights.

The earliest occurrence of 90F or higher was March 22 and the latest occurrence October 4. A record for the number of days with a temperature of 90F or higher during one month was established in July, 1878, with 21 days.

To complete the data on extremes during the cooling

season, Fig. 5 for July 17, 1908, illustrates the day of maximum wind when velocities were high throughout the greater part of the cooling day. The extreme wind for this season reached a value of 70 m.p.h. (1 min. velocity) and a maximum velocity (5 min. period) of 68 m.p.h. on July 30, 1913, but these values were of short duration and not as important as those of the first day.

Some of the dry bulb and wet bulb temperatures for 1933 are shown below since that year was the worst at that time of any since 1905.

Day (1933)	Wet Bulb Temperature	Dry Bulb Temperature
June 8	80.5	95
9	82.5	100
30	80.0	95
July 31	80.8	97
Aug. 1	80.7	98
2	79.0	94
3	78.7	92

Other record days are as follows:

Wet Bulb Temperature		Dry Bulb Temperature	
May 27, 1933	75	May 23, 1925	97
Sept. 22, 1931	80.5	June 9, 1874	102
Oct. 1, 1933	73.4	Sept. 7, 1881	104

For the heating season, Fig. 6 is included to show the record value of 15F below zero reached on Feb. 11, 1899. This is also the date of the great blizzard when snow fell to a depth of nearly 2 ft. which, when added to that already present, made a total of 3 ft. High winds accentuated the cold and piled the snow into huge drifts.

Other records of importance in the heating season are shown by Figs. 7, 8, 9. The maximum wind occurred on March 2, 1914, when an extreme value of 72 m.p.h. was recorded. Graphs for March 1 and 3 are included in order to show what the combination might be since both these days are extremes by themselves.

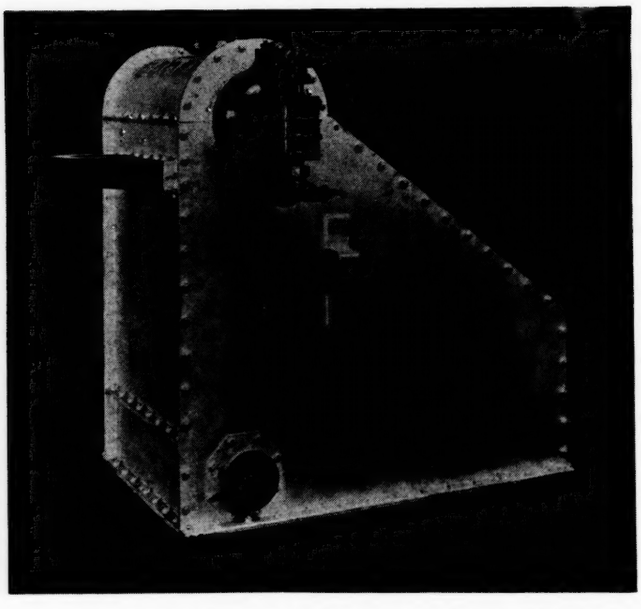
Fig. 10 is included for contrast. It shows conditions on an average day with 100% sunshine. The extreme conditions shown on Figs. 1-9 were of short duration and hence are not design conditions. Building structures and furnishings tend to alleviate the effects of outdoor extremes because of the lag in time between the incidence of the temperature and the absorption of the heat by surfaces in the heated atmosphere.

Although the extreme conditions were 106F dry bulb, 82.5F wet bulb and 79F dewpoint, the design conditions generally used are 97F dry bulb, 79F wet bulb and 75F dewpoint. Design conditions are those encountered every year. They are not simultaneous readings but give a maximum value of sensible and latent heat out of doors as well as a maximum absolute humidity to consider in the dehumidifying capacity.

The hours of sunshine of importance in air conditioning an office building are between 8 a.m. and 6 p.m., the average cooling period. In a study of the years 1932, 1933, and 1934 for the period from May through October, the average number of hours of sunshine per season was 802. An interesting curve can be prepared to show the average number of hours of sunshine on days requiring cooling for various dry bulb temperatures. A cooling day may be considered to be any day with a dewpoint temperature of 55F, a wet bulb of 60F and a dry bulb of 78F, for example Fig. 10.

Waterless Boilers

RESEARCH and experimentation are rapidly inducing industry to recognize the fact that there are materials of far superior characteristics, for the accomplishment of results desired in manufacturing processes, than those which man first found available on this planet.



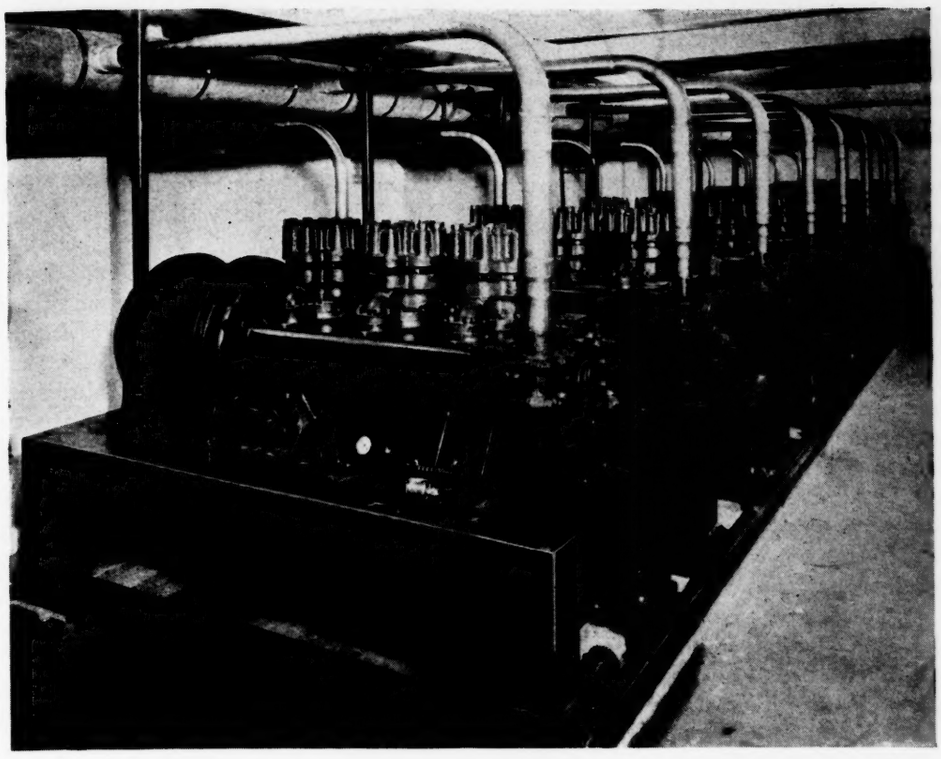
This boiler uses, instead of water a substance which boils at 500F under 135 lb. pressure.

Water and steam were logical heating media because of availability, cheapness and high specific heat. The limitations of the water group became more and more evident as higher temperatures involved high pressures, and the accompanying expense of heavy construction and loss of the latent heat of evaporation, according to "Heat Engineering."

Many substances have been tried in recent years—some of them very successfully—in the attempt to eliminate the disadvantages of water and steam when working in the higher range of process heating. One of the more successful materials is Dowtherm "A" which boils at 500F and reaches a temperature of 750F at a pressure of only 135 lb. per sq. in.

The accompanying illustration shows the smallest size Dowtherm boiler so far produced. Three of this size are in service and are particularly interesting because they have proved advantageous as heating units, although their capacity is nominally only 100,000 B.t.u. per hr.

A small oil or gas burner is placed at one end of a furnace of ample proportions, the furnace being cooled by wall tubes carrying the fluid to be heated. This provides a construction of long life, high efficiency and compactness. The temperature is controlled by thermostat and, due to the closed system, an occasional inspection is all that is necessary in the way of attention by an operator.



Simplified Method of Sizing Refrigeration Piping for Air Conditioning

By DEANE E. PERHAM†

There has long been a demand for simple and easily applied data for determining pipe sizes necessary when refrigeration equipment is used for air conditioning. The author presents tables, similar in arrangement to those used for steam and hot water piping, by means of which pipe sizes for the liquid line and the vapor suction line can be determined. Examples are worked out to show how the tables are applied.

PROBABLY the ideal refrigerating system would have no piping to convey the refrigerant from one part of the apparatus to another. Like all ideals this condition is not attainable in practice and consequently the questions of refrigeration piping design have to be faced. Among the important considerations in such design are those of selecting a pipe of proper material, of sufficient strength and stiffness, and of adequate size; and to have this piping erected and fabricated in a way that will prevent loss of refrigerant through leaks or other ruptures.

Refrigerant piping for air conditioning installations is not different in principle from such piping designed for use with refrigeration elsewhere. Differences are due largely to the refrigerant's temperatures and pressures, along with the necessity of being especially sure of safety where comfort cooling is the objective.

While there are thus a number of considerations in connection with the design of refrigeration piping, of which the determination of a suitable size for the pipe is only one, the aim here is to deal largely with the one item of pipe sizing.

Keep the Pipes Large

In order to get the essentials clear at the start it is necessary to keep in mind the general conditions present when a gas or vapor or a liquid is confined and flows along a pipe. The flow is always accompanied by friction and this friction represents a loss of energy; a loss to be avoided, for energy costs are high. The friction is measured by a loss of pressure. This loss increases as the length of pipe increases and also as the speed of the flowing refrigerant increases so long as the pipe diameter is unchanged. The loss can be reduced by keeping the length of the piping at a minimum and by allowing for generous pipe diameters with the refrigerant flowing at low velocity. From this situation comes the general rule in refrigeration piping; viz.: *Keep lengths at a minimum and provide generous pipe sizes.* The practical importance of keeping velocities

†Director, Refrigeration Division, Chicago Master Steam Fitters' Association, Chicago.

low by using pipe of adequate size can be comprehended when it is stated that it has been estimated that each ounce of pressure drop in a low pressure refrigerant suction line consumes approximately one horsepower-hour per ton per month.

Pipe May be too Large

However the whole case is not stated by dwelling only on the reasons for keeping the pipe sizes large. With some refrigerants now commonly used for air conditioning a lubricant is carried around with the refrigerant and if the speed with which the refrigerant flows is reduced too much, the lubricant will not circulate, bringing about operating difficulties. Also it should be kept in mind that the unit cost of piping increases as the size of the pipe selected is increased.

From this it will be apparent that the selection of a suitable size for refrigeration piping is a matter of much practical importance for there are troubles to be encountered by erring—either toward too large pipe sizes or too small sizes. Capacities of related equipment are involved, and the many variables due both to the properties of the refrigerant used and to the peculiarities of each individual installation, make the size selection to fit a particular job a subject well worth careful study.

Where Must Piping be Considered?

In Fig. 1 is shown a diagram of a typical refrigeration plant operating on the compression cycle. The refrigerant is a vapor in the piping from the point (A) where it emerges from the cooling coils to the point (D) where it enters the condenser. It is a liquid from the point (E) where it leaves the receiver until it enters the cooling coil at (F). The vapor piping A-D is composed of the part A-B on the suction side of the compressor where the vapor is under low pressure, and of the part C-D where the vapor has been compressed and is under high pressure. There are thus three parts of the refrigeration piping in every compression installation; viz.:

1. The Vapor Compression Line, also called the hot gas line (C-D),
2. The Vapor Suction Line (A-B), and
3. The Liquid Line (E-F).

Attention is now directed to each of these three lines separately.

Vapor Compression Line

The vapor compression line joins the compressor to the condenser. The refrigerant must pass through it as fast as the compressor delivers it and as fast as the condenser changes it into a liquid. Control of the flow rate can be secured by varying the speed of the compressor or by varying the rate of flow of condenser water; by varying the temperature of the condenser water; or by all these combined. The nature of the flow also depends on the operating characteristics of the compressor, a multi-cylinder compressor tending to smooth out the pulsations of pressure imparted to the vapor in the piping with each compression stroke of the pistons. A centrifugal compressor, operating without pistons, is free of the pressure pulsations of reciprocating compressors. In all such piping the refrigerant leaves the compressor and enters the piping with considerable speed but this speed of flow drops as the vapor condenses in the condenser. The problem of suitably sizing this section of the piping is thus especially complicated by a variety of peculiar considerations.

Owing to compressor and condenser design the problem of selecting the size of this particular section of the piping becomes a factory design problem rather than a field design problem. As shown in Figs. 2, 3, and 4 where the purely diagrammatic arrangement of Fig. 1 is modified to illustrate more nearly commercial[1] arrangements, it will be noted that the compressor, condenser, and receiver are all closely connected with only very short piping between them. All reach the site factory-assembled and mounted on a single base along with a suitable driving device. In this arrangement the section C-D of the piping of Fig. 1 is reduced to a minimum length and since all connections are made at the factory the selection of a suitable size must also be made there. When assembled in this fashion tests and studies at the factory can be used to advantage to determine the most suitable size of pipe for this section. This leaves the two sections A-B and E-F of the piping installation where size determinations vary with each installation and continue as a field problem, namely the Vapor Suction Line (A-B) and the Liquid Line (E-F).

Tables for Selecting Pipe Size

In order to provide a means for determining suitable sizes for these two sections of the piping Tables 1 and 2 have been prepared. Table 1 is for vapor suction lines while Table 2 is for liquid lines. These two tables are arranged in a form similar to that commonly used for presenting tables for sizing steam and hot water piping. Opposite a column of standard pipe sizes appear figures giving the heat load in B.t.u. per hour suitable for each pipe size for the refrigerant used.

It will be noted also that in both tables the column listing pipe sizes refers to the "nominal" pipe size. This is the name by which the sizes are designated by most engineers and contractors in the course of ordinary usage. Tubing is commonly ⅛ in. larger in outside diameter than its "nominal" size, while iron and steel standard weight pipe has outside diameters which bear no steady relation to the nominal size. Use of this method of listing the standard pipe sizes permits applying the tables regardless of whether tubing or pipe is being used.

Since the number of turns, obstructions, or fittings affect the size selection, it is necessary to make allowances for their presence. Their number and their effect on the size vary with each installation. A workable single table is one which will prevent excessive pressure

[1]The diagrams of Figs. 1 to 4 are intended only to show in a simple manner several applications of the compression cooling cycle. Field requirements and equipment design should govern the selection of apparatus and its application but in many instances there are state or city laws with definite requirements which must be complied with.

COMPRESSION CYCLE AND ITS APPLICATION TO AIR CONDITIONING

FIG. 1. - PRINCIPLE OF CYCLE

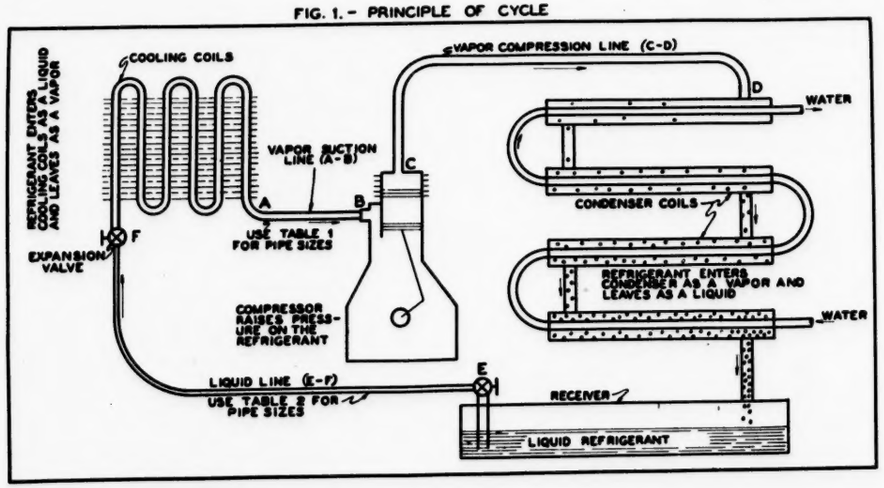


FIG. 2 - APPLICATION WITH DIRECT EXPANSION

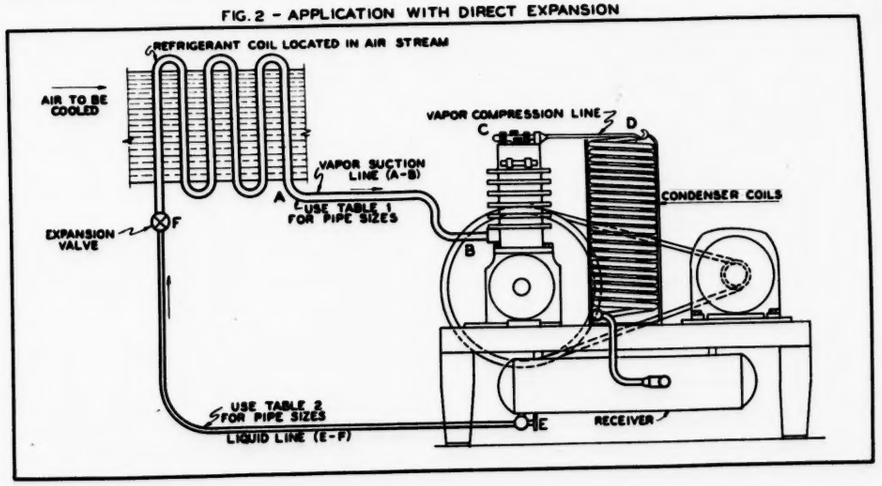


FIG. 3. - APPLICATION WITH INDIRECT EXPANSION (SPRAYS)

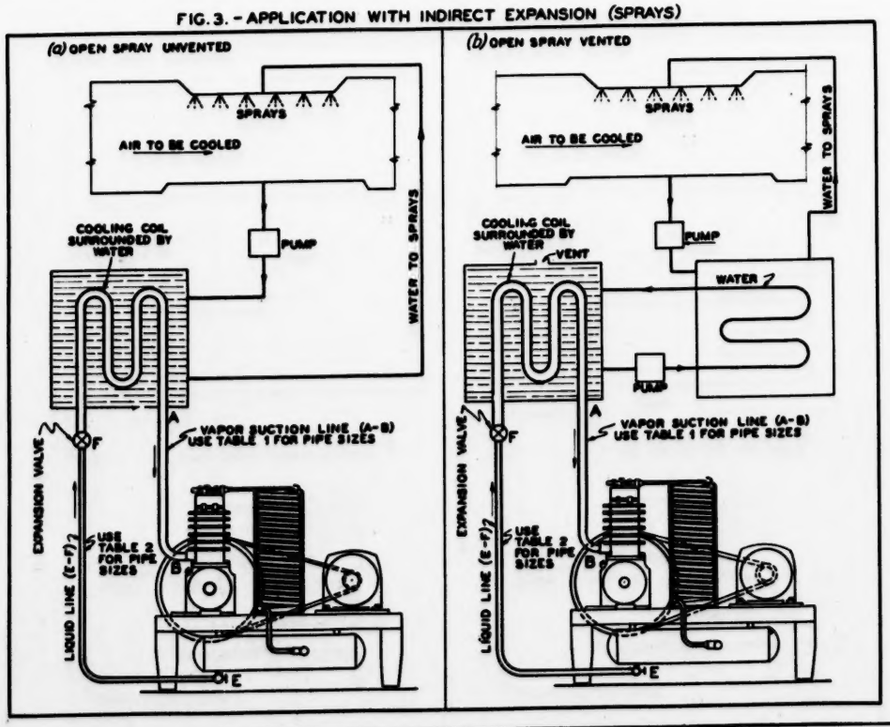


FIG. 4.- APPLICATION WITH INDIRECT EXPANSION (COILS)

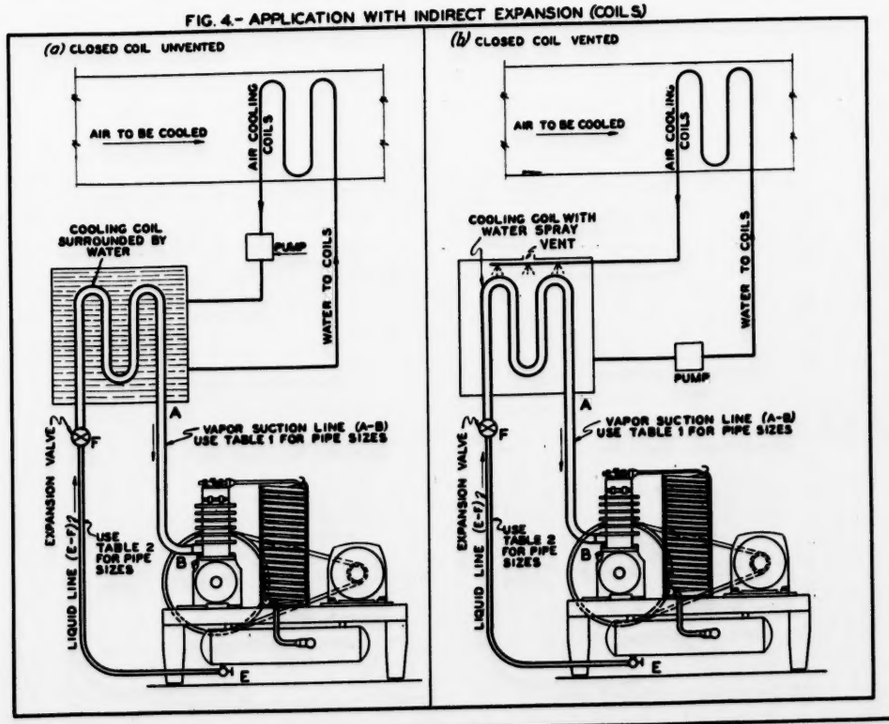


TABLE 1—REFRIGERANT PIPING SIZES FOR VAPOR SUCTION LINES

	Ammonia NH_3		Carbon Dioxide CO_2		F12 CCl_2F_2		Methyl Chloride CH_3Cl		Sulphur Dioxide SO_2	
1	2	3	4	5	6	7	8	9	10	11
Nominal Pipe Size (Inches)	REFRIGERATION LOAD IN B.T.U. PER HR. (FOR EQUIVALENT TONS DIVIDE BY 12,000) (If suction temperature is under 25F, use column headed 5F; if over 25F use column headed 40F).									
	5F	40F	5F	40F	5F	40F	5F	40F	5F	40F
⅛	—	—	—	—	—	—	—	—	—	—
¼	—	—	—	—	400	600	600	900	500	700
⅜	—	—	—	—	3,600	4,800	6,000	8,400	4,800	6,000
½	24,000	36,000	18,000	24,000	6,000	9,600	9,600	12,000	8,400	10,800
¾	48,000	72,000	36,000	48,000	12,000	20,000	20,000	30,000	18,000	24,000
1	96,000	132,000	60,000	84,000	24,000	36,000	36,000	54,000	32,000	42,000
1¼	144,000	204,000	96,000	132,000	36,000	55,000	60,000	84,000	48,000	66,000
1½	204,000	300,000	144,000	180,000	54,000	80,000	84,000	120,000	72,000	96,000
2	300,000	528,000	240,000	324,000	96,000	138,000	144,000	204,000	120,000	168,000
2½	528,000	756,000	360,000	480,000	132,000	200,000	204,000	300,000	180,000	240,000
3	816,000	1,200,000	540,000	720,000	216,000	312,000	324,000	468,000	288,000	360,000
3½	1,080,000	1,560,000	720,000	984,000	288,000	420,000	444,000	636,000	384,000	480,000
4	1,440,000	2,040,000	960,000	1,272,000	372,000	540,000	576,000	816,000	480,000	648,000
5	2,112,000	3,024,000	1,440,000	1,920,000	530,000	800,000	816,000	1,200,000	720,000	960,000
6	3,264,000	4,800,000	2,160,000	2,880,000	870,000	1,250,000	1,296,000	1,872,000	1,152,000	1,440,000
Max. Velocity .	5,000	3,600	900	700	2,200	1,600	3,800	2,700	4,600	3,000

NOTE:—Lines ¾" and Less:—Under 25 lin. ft. as tabulated; 26 to 75 lin. ft. use one size larger; 76 to 150 lin. ft. use two sizes larger.

Lines 1" to 2" Inclusive:—Under 50 lin. ft. as tabulated; 51 to 100 lin. ft. use one pipe size larger; 101 to 200 lin. ft. use two sizes larger.

Lines 2½" and Over:—Under 100 lin. ft. as tabulated; 101 to 200 lin. ft. use one pipe size larger; 201 to 300 lin. ft. use two sizes larger.

TABLE 2—REFRIGERANT PIPING SIZES FOR LIQUID LINES

Nominal Type Size (Inches) Tube O.D. ⅛ In. Larger	Ammonia NH_3 Sp. Gr. = 0.68			Carbon Dioxide CO_2 Sp. Gr. = 0.99			F12 CCl_2F_2 Sp. Gr. = 1.44			Methyl Chloride CH_3Cl Sp. Gr. = 0.99			Sulphur Dioxide SO_2 Sp. Gr. = 1.46		
	Cooling Load		Wt., Lb. per 100 Lin. Ft.	Cooling Load		Wt., Lb. per 100 Lin. Ft.	Cooling Load		Wt., Lb. per 100 Lin. Ft.	Cooling Load		Wt., Lb. per 100 Lin. Ft.	Cooling Load		Wt., Lb. per 100 Lin. Ft.
	B.t.u. per Hr.	Tons		B.t.u. per Hr.	Tons		B.t.u. per Hr.	Tons		B.t.u. per Hr.	Tons		B.t.u. per Hr.	Tons	
⅛	—	—	—	—	—	—	6,000	0.5	—	7,200	0.6	—	8,400	0.7	—
¼	—	—	—	—	—	—	18,000	1.5	3	48,000	4	2	54,000	4.5	3
⅜	180,000	15	3	—	—	—	36,000	3	6	84,000	7	5	96,000	8	7
½	360,000	30	5	240,000	20	5	60,000	5	11	144,000	12	8	168,000	14	12
¾	720,000	60	12	600,000	50	12	120,000	10	24	300,000	25	18	336,000	28	26
1	1,200,000	100	21	900,000	75	21	216,000	18	43	528,000	44	31	600,000	50	46
1¼	2,040,000	170	32	1,320,000	110	32	336,000	28	69	840,000	70	48	960,000	80	72
1½	3,168,000	264	46	1,920,000	160	46	480,000	40	97	1,200,000	100	69	1,344,000	112	104
2	5,052,000	421	82	3,600,000	300	82	840,000	70	172	2,100,000	175	121	2,352,000	196	184
2½	8,160,000	680	128	5,160,000	430	128	1,344,000	112	256	3,360,000	280	192	3,840,000	320	288
3															
4															
Max. Velocity	225 F.P.M			225 F.P.M.			150 F.P.M.			180 F.P.M.			150 F.P.M.		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

NOTE:—Lines ¾" and Less:—Under 25 lin. ft. as tabulated; 26 to 75 lin. ft. use one size larger; 76 to 150 lin. ft. use two sizes larger.

Lines 1" to 2" Inclusive:—Under 50 lin. ft. as tabulated; 51 to 100 lin. ft. use one size larger; 101 to 200 lin. ft. use two sizes larger.

Lines 2½" and Over:—Under 100 lin. ft. as tabulated; 101 to 200 lin. ft. use one size larger; 201 to 300 lin. ft. use two sizes larger.

drop when allowance is made for a reasonable number of fittings and bends. This allowance has been made in computing Tables 1 and 2. Consequently no additional allowance is necessary unless the number of fittings is excessive, in which case their presence can be compensated for by selecting the next standard pipe size larger than would normally be used. This general procedure insures adequate pipe size and in cases where conditions permit lines straight and short, the ideal of no measurable friction loss in the piping may be approached. The only element of individual judgment is the question of when the number of fittings and turns is really excessive. There is no direct answer to this, but experience and exercise of reasonable judgment will keep errors to a minimum. Keep in mind that the general rule is that it is probably better to err on the side of too large a pipe size rather than too small a size.

Provision is also made in both tables for a reasonable method of compensating for excessive lengths of pipe line. In each table footnotes indicate the length of pipe for which the tabulated values should be used and the points where extra allowance should be made. In both tables the maximum velocities assumed as allowable in computing the tables are shown.

In Table 1 pipe sizes are shown for cases where suction line vapor temperature is 5F or 40F. In the great majority of air conditioning installations the column headed 40F can be used since the suction temperature in such work is seldom lower than 25F. Inclusion of the data for temperatures of 25F to 5F, however, makes the table more comprehensive, permits its use in sizing piping for commercial refrigeration purposes, and gives an idea of how a change in suction gas temperature affects the carrying capacity of the piping.

In Table 2 the capacities of the pipes are given in B.t.u. per hour and also in tons of refrigeration effect since refrigeration loads are so frequently stated in tons instead of in heat units per hour. The right-hand column under each refrigerant shows the weight of liquid refrigerant contained in each 100 lin. ft. of liquid line. This information is frequently desired when determining the amount of refrigerant necessary to charge the system.

Use of the tables is illustrated in the following examples.

Example 1. A methyl chloride refrigerating system for handling an air conditioning load of 40,000 B.t.u. per hr. has a vapor suction line 33 ft. long. What nominal size pipe should be used?

Solution: Refer to Table 1. Since no specific vapor suction temperature is given, assume that the suction temperature is greater than 25F, and that therefore the solution will be found in column 9 in the division headed Methyl Chloride. Move down this column until a figure equal to or greater than 40,000 is reached, in this case 54.000. Read horizontally to the left to column 1 and find that a 1-in pipe would be called for. Examine footnote at bottom of Table 1 and note that for pipes of 1 in. to 2 in. in diameter the tabulated figures apply up to lengths of 50 ft. of pipe. Since the 33 ft. of pipe line is less than 50 ft., no additional allowance is made and the size selected is 1-in. pipe.

Example 2. What pipe size would be selected for the vapor suction line in Example 1 if ammonia were the refrigerant instead of methyl chloride?

Solution: Refer to Table 1. In column 3 move down to a figure equal to or exceeding 40,000 and find 72,000; move horizontally to column 1 and find that a ¾-in. pipe size would be ample since the 72,000 figure is greatly in excess of 40,000.

Example 3. A refrigerating system using F12 and operating with a vapor suction temperature of 35F on an air conditioning load of 40 tons has a vapor suction line 210 ft. long. What pipe size would be selected?

Solution: Refer to Table 1. The solution definitely falls in column 7. Read down this column to a figure equal to or exceeding 480,000 (equals 12,000 x 40T) and find 540,000 in this case. Move horizontally to column 1 and find the pipe size as 4 in. Refer to the footnote and observe that for vapor suction lines 2½ in. and over, the tabulated values apply only up to 100 lin. ft. of pipe; for lines over 200 ft. long the note instructs to add two pipe sizes. By this rule the required pipe size becomes 6 in. instead of 4 in.

Example 4. A methyl chloride refrigerating system for handling an air conditioning load of 40,000 B.t.u. per hr. has a liquid line 61 ft. long. What nominal pipe size should be used?

Solution: Refer to Table 2, and note that the solution will be found in column 11 under Methyl Chloride. Move down column 11 until a figure equal to or greater than 40,000 is reached which in this case is 48,000. Move horizontally to column 1 and note that a ¼-in. pipe would be indicated. Refer to the footnote on Table 2 and observe that for lines ¾ in. and smaller the tabular figures apply for lines under 25 ft. long. Since this line is 61 ft. long the note states that the pipe size should be one size larger than indicated in the table. Therefore select the pipe size as ⅜ in. instead of ¼ in.

Example 5. A refrigerating system using F12 and operating on an air conditioning load of 40 tons has a liquid line 181 ft. long. What pipe size would be selected?

Solution: Refer to Table 2 and note that column 9 is the one where the solution will be found. Move down the column until a figure equal to or greater than 40 is found. In this case the exact figure 40 is reached. Move horizontally to column 1 and find that a 1½-in. pipe is indicated. Refer to the footnote under Table 2 and observe that an allowance of two pipe sizes over that shown in the table should be made because of the excessive length of the liquid line. Therefore a 2½-in. pipe size is selected.

Example 6. How many pounds of F12 would be required to fill the liquid line selected for Example 5?

Solution: Refer to Table 2 and note that column 10 contains the solution. The pipe line is 181 ft. long, or 1.81 hundreds of feet. Move down column 10 until opposite the 2½-in. pipe size and read 256 as the pounds of F12 required per 100 ft. of pipe. Therefore the line will hold 256 x 1.81, or 463.6 lb. of F12.

Galloway

Air Conditioning the Newspaper Plant

By ROBERT T. WILLIAMS†

The author, in this paper presented before the recent convention of the American Newspaper Publishers, summarizes the reasons for conditioning and the requirements of each of the departments of a typical newspaper plant

THE principal place in the newspaper plant where air conditioning affects process as well as personnel is the pressroom. The pressroom must be heated; also, I think it will be agreed that a pressroom must, in some way, be ventilated. To these two commonplace requirements, modern practice indicates the humidification of a pressroom, and the provision of some method of carrying away the enormous amount of heat generated by the press in operation. It is generally agreed that humidification of a pressroom results in better press work; in better, sharper looking paper, and snappier halftones. With the increase in use of pictures, both in the news and advertising columns, this is a matter of great value to the newspaper publisher. The humidification of a pressroom keeps the paper in a softer condition, giving it a better printing quality, partly due to its absorption of moisture and partly to the elimination of static electricity which keeps the fuzz on the surface of the paper lying flat rather than standing up straight. Furthermore, the elimination of static will result in fewer web breaks on the press, as a certain number of these are caused by a certain brittleness of the edges of the paper in combination with a drag caused by static.

A surprising result of the humidification of a pressroom is the reduction in ink consumption of a nature of 10%. This is due to the fact that with paper and rollers in optimum printing, less ink needs to be run to secure proper color than otherwise.

We believe, and a certain amount of experience tends to show, that the humidification of the pressroom tends appreciably to reduce the formation of ink mist. This unpleasant feature of most pressrooms has never been satisfactorily explained. However, one of the causes of it appears to be the generation of a small static charge of finely divided ink particles thrown off by centrifugal force from the rollers at high speed, and humidification, tending to dissipate this static charge, does actually cut down this difficulty. The formation of ink mist appears to increase somewhat according to the square of the velocity of the press; and as presses continue to increase in speed, this problem is going to become more acute. Up until the present time, we have treated this ink mist problem with some success by humidification and by dilution; that is, supplying to the pressroom a large quantity of outside air and furnishing positive exhaust. Work is now being done in the direction of direct ventilation of presses at the source of the ink mist, in order to remove this; but this will again be combined with a humidifying system for supplying the air which will be exhausted.

Any system of ventilation or air handling through which pressroom air passes, must be carefully handled from the standpoint of the fire hazard caused by the accumulation of ink. This is subject to spontaneous combustion and ductwork and filters must be designed to be readily cleaned or replaced.

The essential requirement in a pressroom is, therefore, the maintenance of a reasonably high relative

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humidity. The maintenance of what we would call comfort conditions is not of essential importance, inasmuch as the personnel are few in number and are accustomed to relatively high temperatures. It is, therefore, entirely practical to condition a pressroom using what is called evaporative cooling. This gives all the requirements for proper pressroom operation and at the same time, dissipates the heat of the press to such an extent that conditions, while not perfect, are greatly improved, and accomplishes this at a cost of approximately half of what a complete air conditioning system with refrigeration would cost.

In connection with the pressroom system, it is desirable to humidify the stock storage spaces, in order to prevent the ends of the rolls from becoming dried out and brittle, particularly when stored near steam coils or in heated areas. This is purely a wintertime requirement, and may economically be done as a sort of by-product of the pressroom system, using the excess of air not needed in the pressroom during winter.

The system of evaporative cooling is in wide use in many industrial plants where there is a very heavy sensible heat load, and it is desired to produce reasonable conditions of comfort, as well as adequate relative humidities.

The stereotype department may also be satisfactorily treated by use of evaporative cooling, producing conditions far more comfortable in winter than otherwise obtained. In such departments, therefore, due to the high concentration of heat load in one or two spots, it is usually desirable to do what is called spot cooling; that is, to design a distribution system so that the operators directly at the pots may adjust the flow of air to blow directly on them as they work, if they desire; or, if not, to turn it in any desired direction.

This movement of air directly on the body, together with its comparatively low temperature, gives a feeling of comfort even in very hot locations, whereas its humidity prevents too rapid evaporation of perspiration, which would lead to chilling and, possibly, colds.

Throughout the newspaper plant and, in fact, in any air conditioning system, it cannot be too strongly stressed that proper distribution is the essence of satisfactory air conditioning. It makes no difference how accurate your control may be, how efficient your cooling service, how adequate the amounts of air handled may be,—if the air is not distributed evenly without unpleasant drafts, and doesn't reach the places where the work is to be done, you have an unsatisfactory air conditioning system; and, in this respect, I should like to point out to you that a fairly good air conditioning system is something like a fairly fresh egg: unless it is *really* fresh it would be better for you to have none. An air conditioning system which is not satisfactory is not only worth nothing, *but* is likely to be actually detrimental.

The matter of satisfactory distribution applies throughout any building, but it particularly applies to locations where heat load is highly concentrated. In a pressroom, it makes very little difference how much air you put in. If it does not reach the interior of the press, where the work is to be done, but merely by-passes across the ceiling — it accomplishes little or nothing.

This is also particularly true of the composing room which requires very careful handling. In the composing room, the problem is one of human comfort under conditions of a very high load, and in relation to people who are highly sensitive to air movement.

A composing room requires a large amount of air to carry the heat and fumes of the pots; at the same time this air must be very carefully distributed, so as not to cause drafts, because linotype operators are the most sensitive people in the world to air movement, sitting as they do, hunched up over a machine all day. It is also true of proof readers, except that the heat load is not so high. Each composing room requires special study and treatment, depending upon the load of the machines, orientation and construction of the room, ceiling height, temperature differentials of air to be used, and many other factors.

The only other department in the plant in which air conditioning affects process is in the photo engraving department. The processes of developing and printing are affected by both the temperature and humidity of the surrounding air, and by the temperature of the developing and sensitizing solutions which again are functions of the wet bulb temperature of surrounding air.

The etching department requires a special exhaust system to carry away the fumes and this exhaust system must be made of acid-proof material and must be connected with acid-proof material. The exhaust requirements of the photo engraving system necessitate the use of 100% fresh air in the photo engraving department, as this air is too contaminated to return to the main air conditioning system.

Improved Ventilation for London Subways

THE London Passenger Transport Board, which operates the subways of the British metropolis, has recently placed an order for four new ventilating fans for the London Underground Railways to be installed at Hampstead, Belsize Park, Charing Cross, and Goodge Street depots, all on the line serving the northern suburbs.

When these new fans are installed there will be more than 80 ventilating plants on the Underground system, having a total capacity of 3,000,000 c.f.m.

At present the air throughout the entire subway system is changed two or three times every hour. When new air is introduced at one point the train is allowed to push it along the tunnel. The weight of a moving column of air in front of a train is about eight tons. Arrangements have, therefore, to be made in the layout of the tunnel so that the effect of that weight is counteracted and drafts avoided.

Merchandise Mart, Chicago.

World's Largest Building Starts Its Air Conditioning Program

By WALTER A. STAHL†

An air conditioning project to require over 5000 tons of refrigeration capacity is not met with every day. Neither is it entered into lightly and without careful thought and planning. Here the author outlines the nature of the existing problem when the Merchandise Mart in Chicago undertook the initial step in providing a comprehensive plan for making air conditioning available to its tenants. He explains the plan adopted, and tells of the features of the initial installation made during the present summer.

WHAT would be your recommendations if you were called upon to design, specify, and handle the problem of air conditioning for a city of 20,000 people? What if this problem were further complicated by the fact that this entire city is housed in a single building under one roof and the working population augmented by 51,000 transients in the course of a normal day—a figure that exceeds 100,000 per day during the two major market periods?

These are the problems confronting the management of the Merchandise Mart, Chicago, the world's largest building: 18 stories high with 6 additional stories in the tower; 5500 windows; over 5 miles of corridors and 93 acres of floor space; filled with 6000 lines of merchandise which, if placed in box cars, would make a train 27 miles long.

In keeping with the modernity of the structure and the advanced merchandising principles upon which the building was founded, the management has given consideration to an additional service that would promote greater tenant satisfaction and provide greater comfort for the nation's wholesale buyers. That service is air conditioning.

A start is being made this year on this enormous project. The present plan includes a central plant located at the track level of the building. A room has been provided with sufficient space for all refrigeration machines that would be required to cool the entire building. Additional space has been provided for condensing and chilled water pumps and similar auxiliary equipment. Due to the great amount of electric power necessary when the entire structure is cooled, a transformer room has been planned adjacent to the machine room. It is estimated that not less than 9000 hp. will be required for the compressors and auxiliary equipment when the entire building is served.

The machine now installed consists of one 350-ton centrifugal unit with a 400-hp. variable speed motor. It is estimated that five additional machines of 1000 tons each will be required.

Fortunately the problem of condenser cooling is simpler than in most large Chicago buildings, as the

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Mart is located on the north bank of the Chicago River. An intake crib has been constructed at the river capable of taking in enough condensing water for the entire refrigeration requirements of the building. The present 14-in. intake line, sufficient for 2000 tons of refrigeration, is brought into the building through a tunnel sufficiently large to accommodate all additional future lines needed for the project. About 10,000 g.p.m. of water will be required when the installation is complete.

The river water at the crib is passed through a removable 3 ft. x 5 ft. screen with a ⅜-in. mesh, and is drawn in through the 14-in. line to a twin strainer by means of a centrifugal pump. Due to the fact that the pump location and compressor intake are above river level, a vacuum primer has been provided to fill the intake water line. After passing through the condenser tubes the discharge is carried back to the river through another 14-in. line located in the same tunnel. The discharge crib is located about 60 ft. down the river from the intake crib. The 14-in. discharge line is welded into a 26-in. discharge pipe along the dock wall, which pipe is large enough for future requirements.

Chilled Water Distribution

The chilled water riser from the compressor is 14 in. in diameter and is located in one of the central stair wells. The weight of this riser and also the return is carried by a special elbow supported on a steel column provided with a separate foundation. This elbow construction is shown in Fig. 3. The water in the chilled water risers will be maintained at a temperature of 40F to 45F. Laterals have been extended from this line to the fan rooms of sections which are being conditioned this summer. It is estimated that four such lines and returns will be required to cool the entire building.

The revising of the present system of ventilation and air distribution, in order to make it suitable for air conditioning purposes, presented a difficult problem.

The plans for the Merchandise Mart followed in the original construction called for warehouse space from the second to the seventh floor with the upper floors occupied by sales offices. This presented problem number one from the ventilation angle. Floors designated for warehouse space were constructed with no ventilation except for exhaust. Upper floors were provided with two fan rooms, one at each end of the building from which fresh air was dispatched through ducts for the entire floor. Due to the size of the building—210,000 sq. ft. to a floor—duct runs were very long, in some cases in excess of 400 ft. and designed to serve large areas. This arrangement did not provide the flexibility needed when the floors were divided into small spaces. Modern air conditioning required better distribution of air so that additional fan rooms were necessary.

Early last year the demand for space in this great wholesale center became so great that the management was forced to change the type of occupancy of the lower floors originally laid out for warehouse space. This decision made it possible to lay out the ventilation system in these new units in such a manner that these spaces could be air conditioned in the future simply by installation of conditioning equipment in the fan rooms and means of supplying chilled water to the coils.

Each floor of the Mart is divided by fire walls into seven sections of approximately equal areas. The new ventilation system provides for a fan room for each section, furnishing approximately 25,000 c.f.m. A total

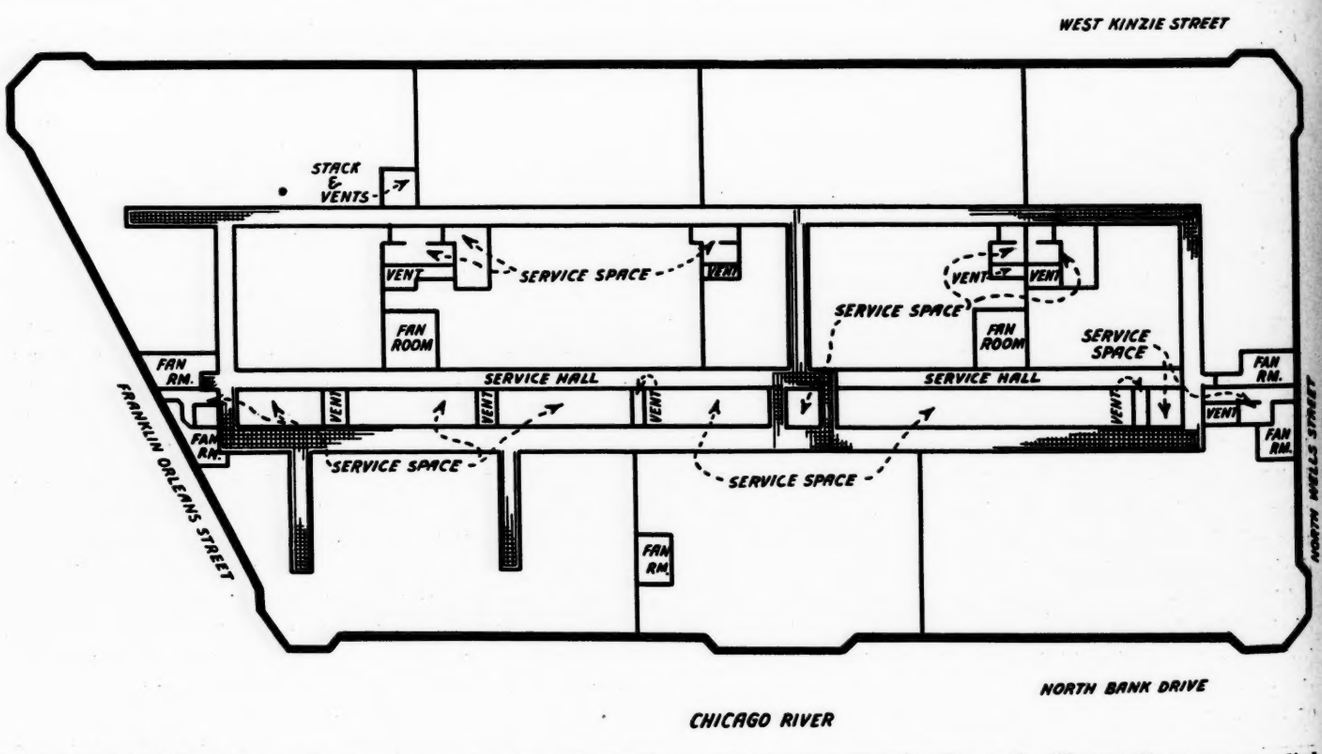


Fig. 1. Typical floor plan of the Mart showing fire wall divisions and fan room location for each. Five sections are supplied with air from outside fan rooms. The two centrally located fan rooms draw air from large former conveyor shafts.

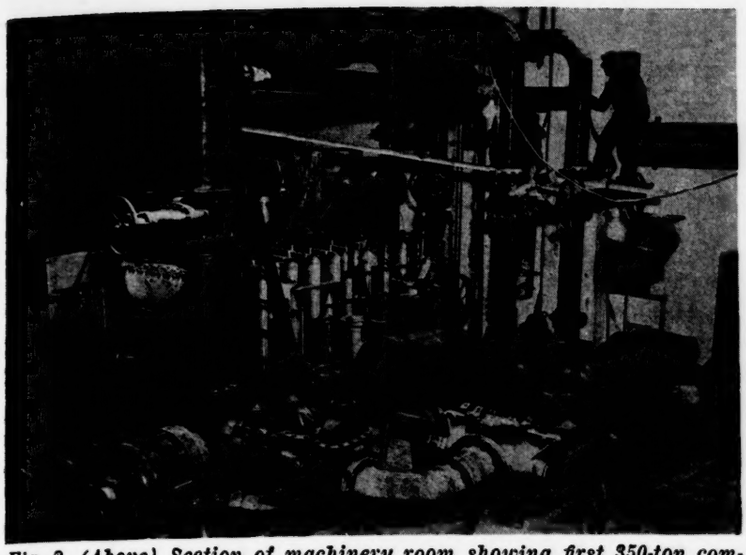
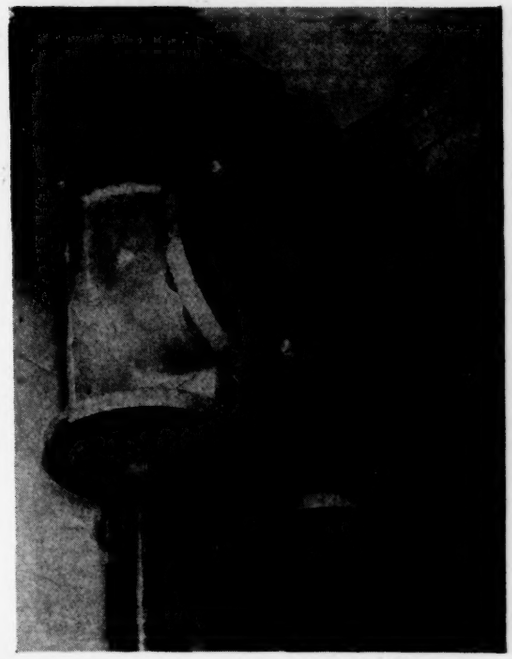


Fig. 2. (Above) Section of machinery room showing first 350-ton compressor and auxiliary equipment being installed. Intake line from tunnel at extreme right foreground.

Fig. 3. (Below) 25-ton chilled water risers called for special foundations, individual supporting columns, and a special T.



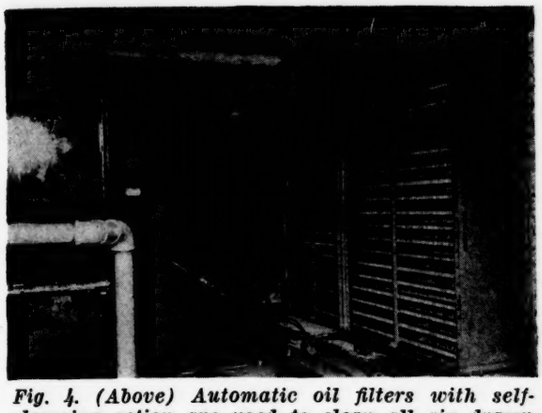


Fig. 4. (Above) Automatic oil filters with self-cleansing action are used to clean all air drawn into the Mart.

Fig. 6. (Below) Diver descending to cut a hole four foot square in sheathing of dock wall to provide opening for cribs.

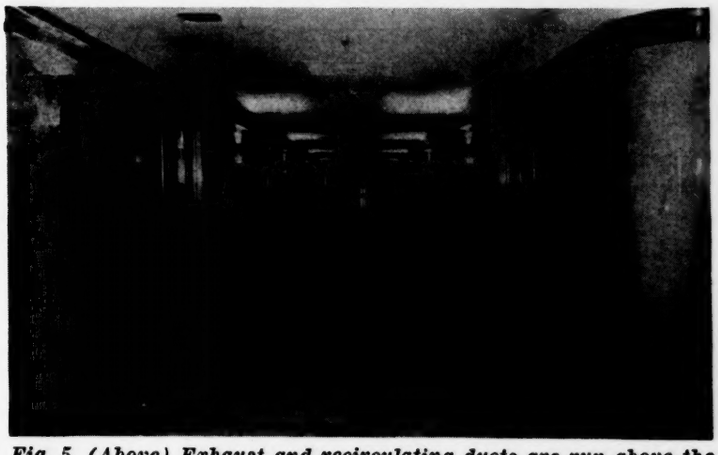
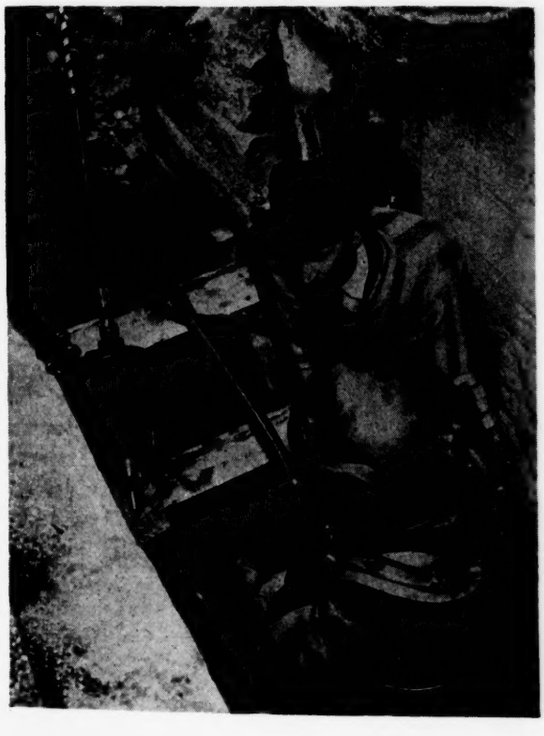
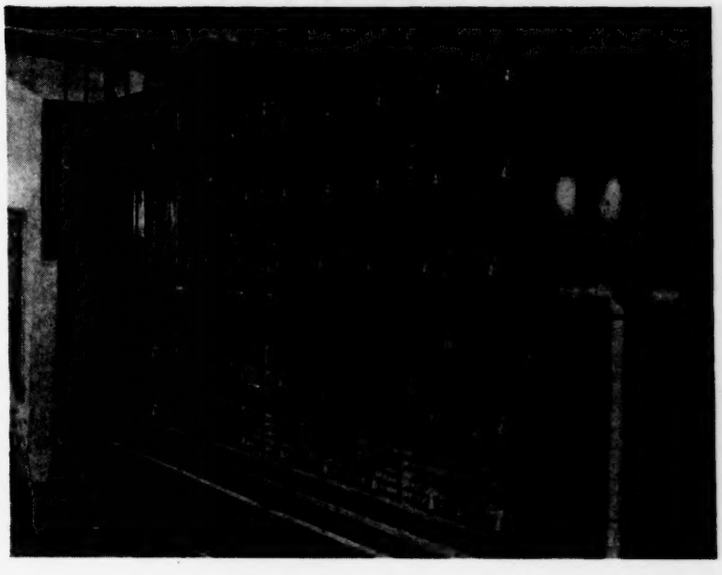


Fig. 5. (Above) Exhaust and recirculating ducts are run above the cove ceilings of the corridors, while grilles in doors allow passage of air from tenant spaces into corridors.

Fig. 7. (Below) Cooling coils with housing removed to show coil air cleaning spray nozzles.





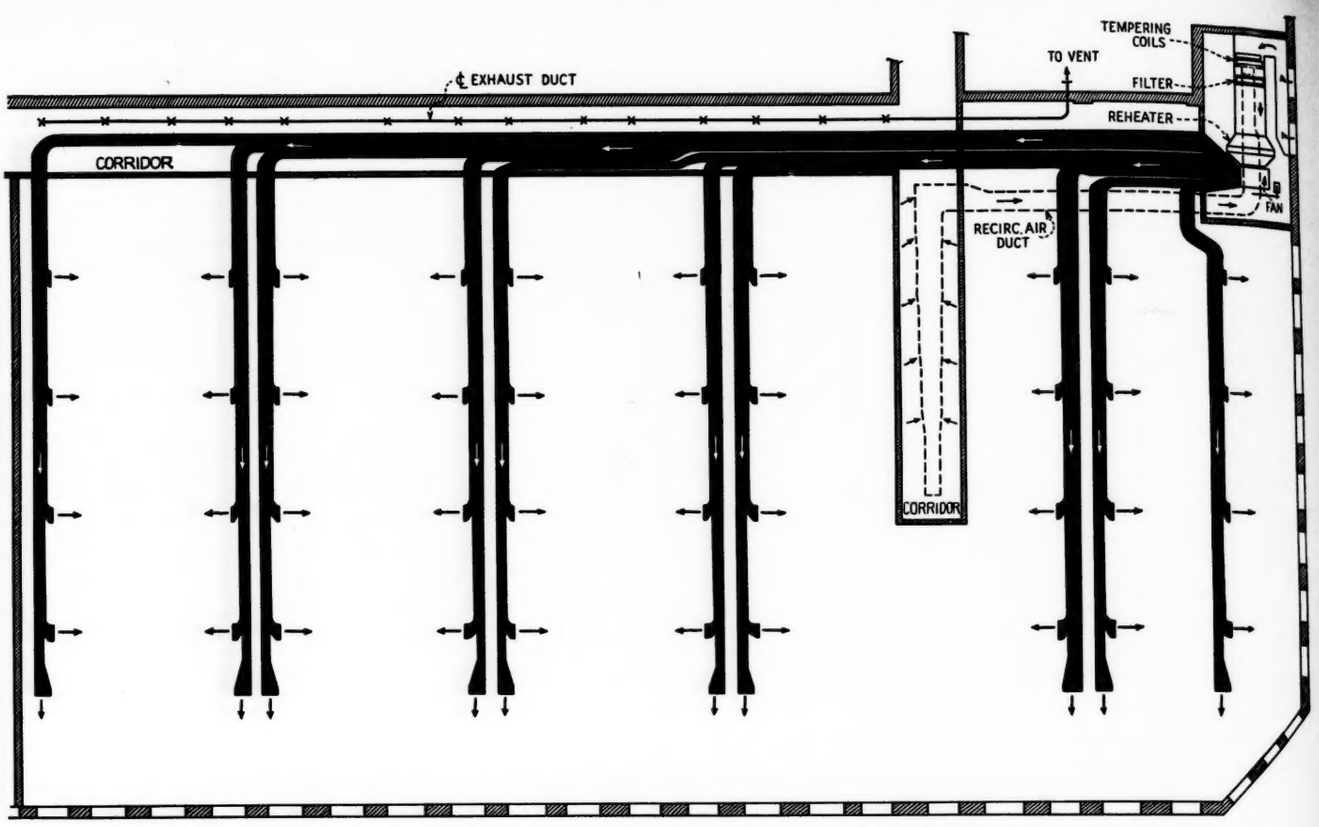


Fig. 8. Typical duct arrangement for one of the seven sections of the Merchandise Mart. Fire walls have made this section approximately 30,000 square feet.

of 3,500,000 cu. ft. of air will be handled per minute for the total requirements of the building. Some of the fan rooms are located on the outside walls of the building, taking the air through the windows, while others draw the air from ventilating shafts at the center of the building. Fig. 8 shows a typical section of the building served by a single fan room. It is evident from the diagram that the air is introduced into each bay of the section in a manner that permits flexibility together with a minimum amount of duct work regardless of the size of tenant areas.

Ceiling height in display rooms is a dimension that cannot be sacrificed, so duct installations are laid out with the large exhaust and recirculating ducts in the corridors. Corridor ceilings are furred down to a height of approximately eight feet to allow for main ducts above. Grilles are provided in the bottom of all doors leading into tenant areas which permit the air to be drawn from the spaces into the corridors from where it passes into the exhaust duct. The typical layout provides for a double door in each 20-ft. bay.

Separation of Conditioned Areas

Inasmuch as the entire building will not be conditioned at the same time, it was necessary to find a means to shut off conditioned areas without impeding traffic to and from these areas. This has been accomplished by the installation of glass partitions with automatic swinging doors in the corridors. These partitions have been designed to offer little visual obstruction to the continuity of the corridor, yet effectively separate conditioned areas. Present installations will provide temperatures not exceeding 80F in 95F weather and provide a humidity not exceeding 55% when maximum wet bulb temperature of outside air entering the system does not exceed 75F.

Due to the many types of occupancy in the Merchandise Mart the refrigeration needs of the several floors and sections of floors vary considerably. For example: the needs of the 12th floor where 90% of the leading lamp manufacturers of the country are located are very high, as the current consumption averages 5 watts per sq. ft. with the resultant high heat gain. This can be contrasted with the furniture floors with an average current load of 2 watts per sq. ft. or less. The 18th or top floor of the main structure presents another problem. Its load is large because of the great expanse of roof area. Insulation of the entire roof is under consideration at the present time to reduce this load. Floors which house large general offices with thousands of employes must be treated differently than those with sales rooms with a lesser occupancy.

The Merchandise Mart management feels that the present plan is a practical solution for its air conditioning problems. The limited installations which have been made this summer will afford a definite check on the cost of operating and maintaining the equipment. Additional equipment will be installed in the next several years in accordance with the tenant demands. At the present time it is intended that at least two additional floors will be conditioned for operation in the summer of 1938.

The air conditioning and refrigeration machine was furnished by Carrier; Phillips Getschow Co., Chicago, did all of the piping and R. B. Hayward Company the sheet metal ductwork.

Steam Traps and Their Characteristics

3.—Expansion, Orifice, Impulse and Siphon Traps

By T. NAPIER ADLAM†

Steam traps operating on the expansion principle are useful in many applications and have been in existence over a long period. The author explains how both liquid expansion and metal expansion traps function and also includes descriptions of the operation of several other types of traps.

LIQUID expansion traps, as illustrated in Fig. 14, contain an element, E, which is constructed with a corrugated tube, T, filled with a suitable expansible liquid, L, after which it is hermetically sealed with the screw, S.

Hot condensate or steam passing over the element, E, will cause the liquid to expand and compress the tubing, T, thereby pushing the rod, R, and valve head, V, forward, closer to the inlet valve. The higher the temperature of the condensate the greater will be the movement by expansion and, consequently, the more travel of the valve head until it finally expands sufficiently to close the inlet valve, C, entirely. Adjustments can be made by turning the nut, N, so that the trap can be made to close at any temperature desirable.

Should condensate at any temperature above 212F pass the valve, C, and enter the trap body, it will immediately be subject to some re-evaporation causing its temperature to drop to 212F provided the discharge pipe is open to atmosphere. This means that when the discharge side of this trap is subject to atmospheric pressure only, the highest temperature possible to which the element, E, can be subjected will be 212F only; so that in setting the trap for closing off, the adjustment has to be made so that the element will definitely close the valve, V, when the temperature of the discharge is 212F. Although this is the highest possible temperature for the discharge under atmospheric conditions, the trap may be adjusted to discharge at any lower temperature desired.

To make an adjustment to this trap the union nut, H, is first loosened very slightly and then the adjusting nut, N, is turned either to the right or to the left, for higher or lower temperature, respectively, after which the union nut, H, is again locked tight and the trap is ready for use.

P is a safety spring inserted in a case and compressed to give an initial tension more than necessary to hold the valve closed against the highest pressure to which it will be subjected. Any extra expansion which might occur if scale or dirt on the valve seat allows the steam to leak past and raise the temperature very high will be taken care of by the compression of this spring.

Assuming this type of trap to be installed for draining the condensate from a vessel or pipe containing steam at say 100 lb. pressure, the highest temperature at which the condensate can be formed will be 338F. If some of this high temperature water passes the valve, C, it will immediately flash into steam but it will also expand the element and close the trap, which will remain closed and hold back the condensate in the vessel or connecting pipe until it cools down to 212F. Consequently, although the condensate is formed at 338F, it will not pass the trap higher than 212F.

If lower discharge temperatures are required, it is possible, with a suitably charged element, to obtain any temperature down to 70F or 80F with an adjustment range of 15F to 20F above and below the factory setting point; consequently, the liquid expansion trap is very useful in being able to give a wide range of setting temperatures, which is found economical in draining coils.

Although 212F is the highest attainable temperature when the discharge is at atmospheric pressure, it is possible, with a suitable back pressure on the outlet of the trap, to operate at any reasonable temperature above 212F. This function of a liquid expansion trap enables it to be used as an indirect temperature controller, and in this respect it has a wide field of application when applied to condensate discharge from a vessel, in direct contact with the liquid to be heated, or inserted in steam inlet to small steam heated equipment.

Because of the efficiency obtainable when discharging condensate at low temperature, this trap is widely used for draining factory heating coils, large outside tanks, and in many places where the condensate has to be thrown away and cannot be returned to the boiler.

Restricted Orifice Traps

This type of trap is commonly recognized as one in which the condensate passes through a small orifice or a restricted passage, the area of which is either permanently set or adjustable so that it can be varied to suit prevailing conditions.

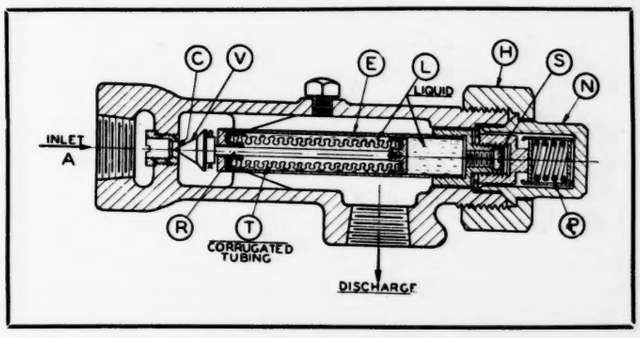
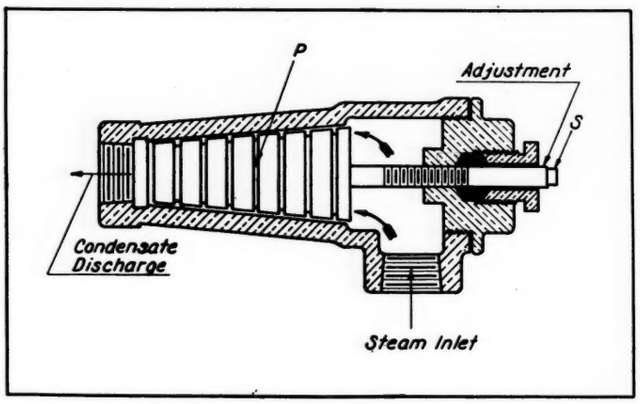


Fig. 14. Section through steam trap operating on liquid expansion principle.

†Chief Engineer, Sarco Co., Inc.

Fig. 15. (Below) Restricted orifice trap with tapered plug for adjustment. Fig. 16 (Right) Adjustable orifice trap.



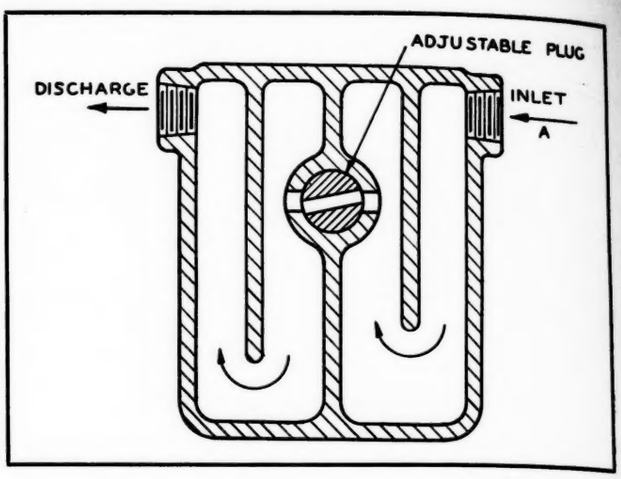


Fig. 15 illustrates one type of trap relying on a series of small grooves to interrupt the flow of steam and allow only water to pass. Adjustment is made by turning the spindle, S, which gradually raises or lowers the plug, P.

Fig. 16 illustrates another type of trap in which an adjustable orifice is inserted in the passage.

Impulse Traps

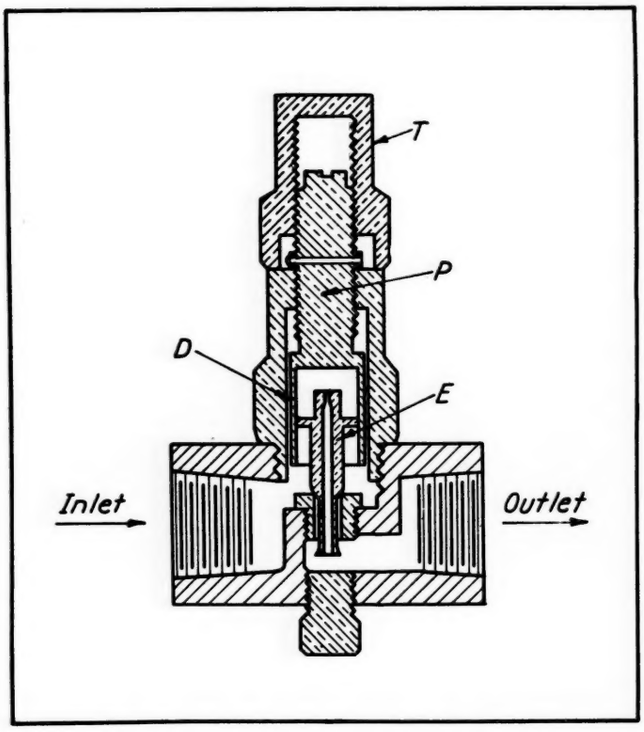
The function of this type of trap is to take advantage of the drop in pressure when water traverses a passage and orifice or two chambers in series.

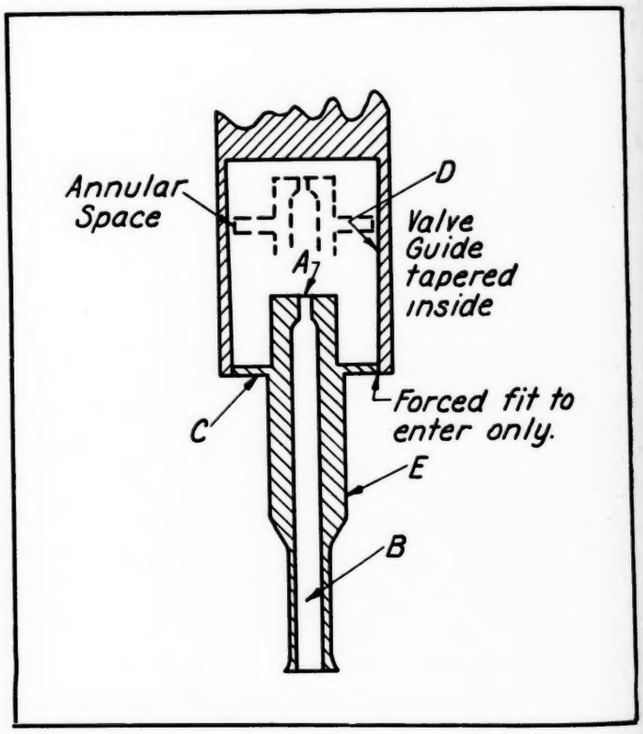
Fig. 17 illustrates a trap of this type where D is an adjustable guide for the valve, E. Adjustment is made by raising or lowering the screwed plug, P, which can be accomplished by removing the cap, T, and turning the plug with a screwdriver.

Fig. 18 gives an enlarged sectional view of the valve and valve guide, from which it will be noticed that the valve, E, is constructed with a thin piston disc, C, which moves up and down in the guide, D, and with an orifice, A, at the top of the valve. The guide, D, is bored taper, so that as the disc, C, rises higher the annular space becomes greater.

The theory of operation is, that when only water passes, the flow between the disc and the valve guide is such that the drop in pressure is greater than when passing through the hole, A, at the top of the valve. This reduces the pressure above the piston, and the pressure on the under side of the piston lifts the valve and allows the water to pass through the seat.

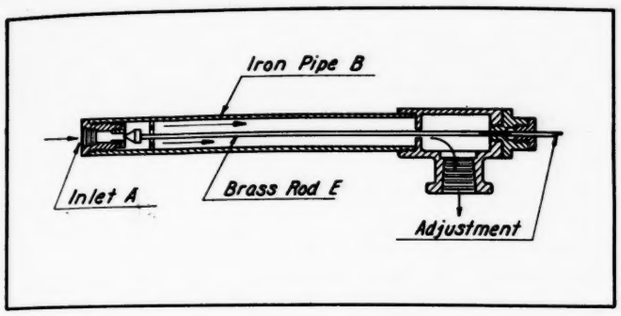
When steam passes the annular space and through the center opening, A, the pressure drop through the annular space is less than with water, so that a pressure is built up on the top of the piston which forces

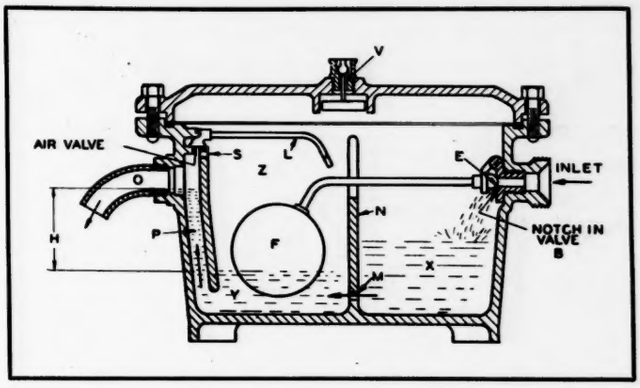




Figs. 17 (Left) and 18 (Right). Steam trap operated by impulse; (17) a section through the trap body; (18) detail of operating mechanism.

Fig. 19 (Below) Metal expansion trap with brass rod and iron body. Fig. 20. (Right) Steam trap operating on siphon principle.





the valve down on the seat and closes it against the passage of steam.

Metal Expansion or Bimetallic Traps

These traps rely on the differential coefficient of expansion of two dissimilar metals. Fig. 19 is a typical illustration of the metal expansion trap and Fig. 21 an illustration of the bimetallic.

Referring to Fig. 19, where the condensate passes in at the inlet valve, A, and travels over the metal rod, R, it is the greater expansion of the rod, R, than of the body, B, which causes the trap to function. Usually, the body, B, is constructed of iron and the rod, R, of brass, and it is the differential expansion of the brass and iron that causes the trap to close when the condensate passing through the trap reaches the correct temperature.

There is usually an adjustment at the end, E, whereby the rod, R, can be moved inwards and outwards so that it closes the valve, A, at a higher or lower temperature as found desirable.

Siphonic Traps

This trap, illustrated in Fig. 20, is interesting because of its age, and while it is assumed to operate with a siphonic action the water level in the trap which determines the amount of opening of the inlet valve, E, is controlled by any slight change in pressure that accumulates in the body of the trap.

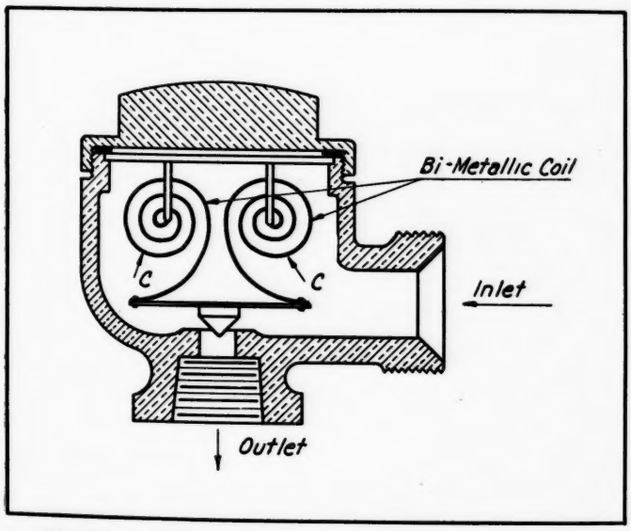


Fig. 21. Metal expansion trap with bimetallic coils.

Condensate enters through the inlet valve, E, and passes from the chamber, X, to the chamber, Y, through an orifice, M, in the partition, N. The partition, N, checks any surging of the water which might take place if the water is blown into the trap under high pressure.

The discharge channel, H, is taken from the bottom of the trap and any slight pressure in the space, Z, will force the water up the passage, P, through the outlet, O; the distance H being equal to the excess pressure in the trap above that at the outlet.

As the water level falls in the chamber, Y, it lowers the float, F, and closes the inlet valve so that no more water or steam can pass.

If the condensate temperature entering the trap is not above 212F there will be no pressure in the trap and the water level will rise to the same level as the outlet, allowing the float to open the inlet valve wide. As soon as water above 212F enters the trap, re-evaporation takes place and a slight pressure is created in the space Z. This slight pressure will force some water out of the trap and lower the level until H equals the prevailing excess pressure. The trap will set itself to work steadily when the inlet valve is sufficiently open to allow any water at 212F or below to pass but will close if the temperature rises much above 212F.

When starting up and only cool condensate enters the trap, the float, F, will rise sufficiently high to lift the lever, L, thereby opening the air valve. This gives a free passage for air to pass through the trap from the machine or coil and allows quick heating up.

If the temperature of the condensate entering the trap is much above 212F and considerable re-evaporation takes place from the water entering the trap, then too much water will be forced out of the trap and the water level will fall sufficiently to close the inlet valve, E, entirely, thus preventing any more water entering the trap. Normally, the trap would remain closed until recharged with water but it is customary to form a niche in the inlet valve head at B which allows a small trickle of water to pass and gradually fill the trap sufficiently to start it operating again. V is a relief valve which lifts at about 1 or 2 lb. pressure so that no great pressure can accumulate in the trap body.

Next month, in the concluding article of this series, the author will explain the calculations for steam trap capacities.

EDITORIALS

The Housing Act Passage of a Housing Act came only as a last minute action by Congress following a bitter fight and continued uncertainty as to whether any such action on slum elimination could be obtained at all. As passed, the act is a collection of compromises between what the advocates wanted and what the opposition would concede. At least the act establishes the principle that the Federal government has an interest in slum elimination and that it will grant assistance to local bodies in attempts to provide modern housing for the poor. At best it may lead to a moderate program of slum elimination and new housing within the next few months.

It is doubtful if any particular impetus to the building construction industry will result from the act within any short period. For one thing, the general idea seems to be to go slow in attacking the slum problem. For another, considerable time will necessarily elapse in getting a suitable organization formed and in getting administrative details in hand. Then, too, there is no way of predicting just how appealing the program will turn out to be to local interests in the various cities. Opposition to the Federal government delving into the slum situation is still powerful and well organized and entrenched. All these considerations lead to the conclusion that we will feel but few concrete results in the way of increased construction volume. The great things expected of slum clearance are still a long way off, and how soon they may materialize depends to some extent on how favorable an impression the operations under the new act make on the country as a whole. This Housing Act is not a repetition of FHA, has but little relation to that program, and should not be expected to provide the quick impetus to construction or to equipment sales which FHA did.

•

City Water Supply and Air Conditioning This month we print city water temperatures for the summer months for a number of large cities as reported by a recent government study. This same study also included data on water resources both present and anticipated in these cities. No sooner had this information appeared than all kinds of interpretations were put on it. We note that a shortage of water for air conditioning purposes is reported in several of the cities. Also that in a number of others water supply officials are concerned about their ability to meet the demands if summer cooling grows in the way that predictions have indicated it may do.

It is probably well that some worrying about the adequacy of water supply is being done dow. It is doubtful though if there is any reason at all to conclude that the spread of summer cooling is going to inevitably require the construction of large works to boost up public water supply. Other means of extracting the heat from the cooling equipment can be substituted for water. Moreover where water is used for this cooling it can be re-used for other purposes or can be waste water which has already been used elsewhere. Then there is always the possibility of going to some combination of air and water cooling of the condensers or even to straight air-cooling at the condenser. These methods are well known to the industry and the principal reason why they have not been more generally applied is because up to very recently public water supply was the easiest and cheapest source. It still is in many cities but as the supply of such water is restricted in any locality the alternate methods of cooling the condensers simply move in. Let's be concerned about public water supply but let us not be unduly concerned about it and about its relation to summer cooling.

•

Control from Outside Automatic controls for operating both heating and cooling plants are now practically standard equipment and regarded as necessary parts. Their acceptance and use have naturally come about gradually as ideas and equipment have gradually taken form. Naturally, too, methods of achieving operating control have been given a great deal of thought and study. Among the more recent trends in connection with controls is the movement toward locating the sensitive elements—really the primary controls—in the outside air rather than in the inside. Although there is so frequently a direct relation between inside and outside temperatures that the control point can be located either inside or outside, there is much to be said for the outside location. The next time you have a control problem look into the possibilities of using outside control. If you haven't kept in close touch with developments along this line you are likely to be surprised at what can be done now that so many temperature controls are available for use in the outside air.

•

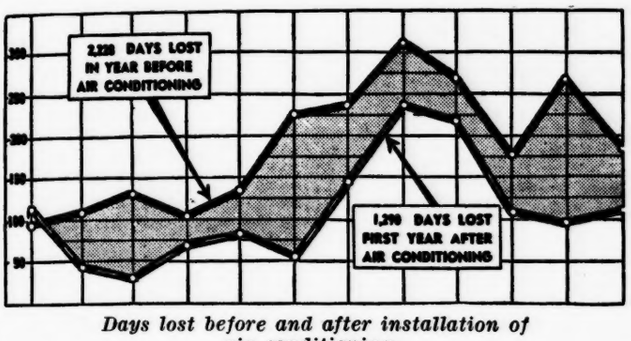
New York Building Code At long last the proposed Building Code for New York City has been acted on by the legislative chamber of the city government. This code was drawn up by a group which seemed well qualified and high hopes of its adoption and enforcement were entertained as long ago as 1932. But the mills grind exceedingly slowly sometimes and now the code is just emerging. It is believed that the requirements covering the provision and installation of heating, ventilating, and air conditioning equipment are the most specific ever written into a city building code. The principal provisions of the code as related to our field were printed as HEATING & VENTILATING'S Reference Data Sheets Nos. 63 and 64, and have thus been available for reference and information for a considerable period.

ENGINEERING NOTEBOOK

Air Conditioning Reduces Sick Leaves 50%

Proof that air conditioning produces definite dividends in employe-health was shown in a survey recently completed by the Chicago Tribune whose building was one of the first 100% air conditioned newspaper office buildings in the country.

The survey was begun in May, 1933, exactly 12 months before the building was air conditioned. At that time there was an average of 2150 persons on the monthly payroll. During the 12 months between May, 1933, and May, 1934, a total of 475 employes were compelled by various respiratory diseases to miss a total of 2228 days' work, an average of about five days each.



Days lost before and after installation of air conditioning.

During the first year of the plant's operation, between May, 1934, and April, 1935, the average number of employes was 2500 per month yet only 345 were ill enough to miss a day's work during that period. Total days lost dropped to 1290 and the average per person was slightly more than three and a half days.

To put it in another way, before the building was air conditioned, 22% of the Tribune's employes lost one or more days through illness while after the plant was put into operation, the percentage dropped to 13%.

Even in the epidemic year of 1936 when influenza was widely prevalent in Chicago, only 571 of the total of 3000 employes of the newspaper stayed at home because of respiratory illness.

●

London Club has Modern Heating and Air Conditioning Installation

Lansdowne House, one of London's leading social clubs, is outstanding among modern London buildings for its efficient and up-to-date heating and ventilating installation. The method employed is a combination of electrical thermal storage and air conditioning. The installation generally is sectionalized, permitting the principal rooms of the club (ballroom, dining rooms, squash courts, swimming pool, and Turkish bath) to be treated separately from an air conditioning standpoint and the temperatures and atmospheric conditions carefully regulated in accordance with its particular use.

The plant rooms are located in the basement. and the entire equipment is electric and automatically controlled throughout. The main kitchen and auxiliary kitchens have a separate supply and exhaust system. The smaller rooms and a special portion of the building are heated by direct heating. The dining room outer walls are fitted with convector panels designed in the manner of sill panels and concealed floor panels. Various other types of direct heating are also installed.

The mechanical equipment is arranged in various chambers so as to give the most efficient operation. A high-tension intake chamber houses the transformers, each of 600 kw., and 6600-400 volts, and the necessary switches. An adjacent chamber contains the low-tension switches in units for distribution to the numerous services in the building.

In the third chamber are located the panels and switches for distribution of all power and lighting to the building, together with the pumps for vacuum cleaning and pneumatic dispatch service. The fourth chamber houses a filtration plant and electrode water heating boiler and sterilizing plant.

The fifth chamber contains the hot water storage and distribution pumps, with controls for domestic supplies, while the sixth has the low-pressure boilers, control panels, distant thermometer panel, and circulating pumps. From this chamber the entire heating of the building can be controlled.

The seventh chamber houses the air conditioning plant. Air is drawn from the top of the building, warmed, washed, and distributed by means of separate fans and local heaters to various sections of the building, each section being thermostatically controlled. The temperatures in the heaters can be varied from that in the radiator heating system. Also in this chamber are the main thermal storage cylinders. The air for the whole of the building is supplied from this room, being exhausted by means of separate fans installed in a special plant room on the top floor of the building. The heat generated in the transformer room, approximately 30 kw., is utilized in the building, thereby increasing the efficiency of the whole plant to practically 100%.

The Turkish bath is adjacent to the plant rooms, and here the thermal storage plant is employed for initial heating, the higher temperatures required being obtained by direct electrical air heaters fitted in the trunking services to the various rooms. These room temperatures are also thermostatically controlled.

●

Fuel Savings Resulting from Insulation of a Residence

An indication of the savings in fuel consumption resulting from various insulations is given in the following information which was obtained during the last three years from an average size residence located in an upstate New York town.

The house in the picture is 28 ft. x 30 ft. 6 in. outside and has two floors with 8 ft. 4 in. ceilings, a cellar

Insulating this house reduced fuel cost 33½%.

and an unfinished attic. Its construction is plaster on plasterboard stud sheathing and stucco with roof of slate on roofers. There are 19 well fitted double-hung windows in tight window frames.

The house is held at 70F during the 24 hours by a thermostat. During the night, three sleeping room doors are closed, radiation shut off, and windows partly opened. During the day all doors are open and the temperature throughout the house is uniform.

With the above construction, operation, 375 sq. ft. of hot water radiator surface and six of the windows fitted with storm sash, the house was quite comfortably heated to 70F using 3.45 lb. of coal per degree day.

Adding four storm sashes and insulating the second floor ceiling with 3 in. of mineral wool under attic floor cut the coal consumption to 3.15 lb. of coal per degree day, or a saving of 8.5% in the coal cost. It also evened up the first and second floor temperatures and improved the temperature above the floor.

In the summer of 1936 the entire outside wall area was insulated with glass wool which still further reduced the coal consumption to 2.3 lb. per degree day or 27%. This insulation also practically eliminated the cold floor due to air drainage from the outside walls.

The saving in the coal bill between 3.45 lb. per degree day and 2.3 lb. per degree day is 33.5%. The house is much more comfortable both winter and summer.

The above data cover three years' operation, each period covering a heating season. Yard weights of coal were used, each load of coal being used up and set against the corresponding degree-days before starting on the next load.

●

Standard Welding Symbols

Realizing that welding cannot take its place as an engineering tool unless means are provided for conveying full information from designer to workmen, the American Welding Society has evolved and published a set of standard welding symbols covering both fusion and resistance welding.

These symbols, shown in Figures 1 and 2, provide the means of placing complete welding information on drawings. They are ideographic; that is, they are picture-writing symbols, showing graphically the type of weld required. In evolving the symbols, the need for simplicity has been kept in mind and the general principle has been followed of having the most common form of any weld requiring a minimum of numerical data. In final form, the scheme amounts to a shorthand system whereby a large amount of information may be conveyed accurately with a few simple lines and numbers.

It is pointed out that, in practice, many companies may require only a few of the symbols, and if they desire, can make up their own legends, selecting such parts of the system as fit their needs and discarding the remainder. In such a case, where a weld departs from the user's standard, supplementary data will become necessary. But, this simply makes the user's standard a part of the symbol system and means only that exact interpretation will vary slightly among different users. On the whole the symbols lay the foundation for a much needed universal welding language.

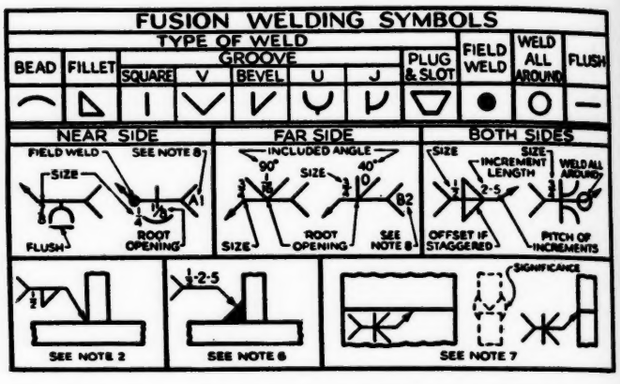


Fig. 1—Legend for use on drawings specifying fusion welding

1. In plan or elevation, near, far and both sides locations refer to nearest member parallel to plane of drawing and not to others farther behind.
2. In section or end views only, when weld is not drawn the side to which arrow points is considered near side.
3. Welds on both sides are of same size unless otherwise shown.
4. Symbols govern to break in continuity of structure or to extent of hatching or dimension lines.
5. All welds are continuous and of user's standard proportions and all except V- and bevel-grooved welds are closed unless otherwise shown.
6. When welds are drawn in section or end views, obvious information is not given by symbol.
7. In joints in which one member only is to be grooved arrows point to that member.
8. Tail of arrow used for specification reference.

Note: All dimensions are in inches.

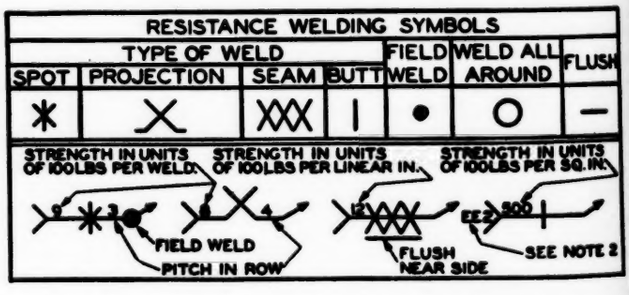


Fig. 2—Legend for use on drawings specifying resistance welding

1. Symbols govern to break in continuity of structure or to extent of dimension lines.
2. Tail of arrow used for specification reference.

Note: All dimensions are in inches.

WHAT READERS SAY• • •

School Heating

As I am a subscriber and constant reader of HEATING & VENTILATING, I thought possibly you might be interested in a copy of a part of my most recent report to the Superintendent of this School district and to the Board of School Directors, which concerns the cost and consumption of fuel.

The February issue of HEATING & VENTILATING contained an article written by H. K. Kugel on "School System Uses Degree-Days To Reduce Fuel Consumption." Naturally this article was of vital interest to me, as I have been using degree-days for some years. The article and the accompanying table have given me some new ideas which I have added to my compiled figures for previous years and incorporated in the inclosed report. . . . —*C. Harold Nordby, Supt. of Buildings and Grounds, School District of Lancaster, Pa.*

. . . The first horizontal row of figures for each building, indicated by the letter A, are averages taken over a period of four years, from the 1932-33 heating season to the 1935-36 heating season, inclusive.

The second horizontal row of figures for each building, indicated by the letter P, are for the present heating season which has just closed.

The second vertical column of figures headed "T. per M. sq. ft." was obtained by dividing the actual floor areas of heated portions of the buildings into the number of tons used, which gives a good comparison year by year, and between buildings.

The best comparison, and the only figures which should be used for accurate comparisons, are contained in the third vertical column headed "lbs. per M. sq. ft. per degree day." To obtain these results the figures in the second column were converted into lbs. by multiplying by 2,000, and the quotient divided by a constant for each year known as Degree-Days. . . .

It should be understood that the fourth vertical column, headed "cost per year," is not the cost of the number of tons used during that year, but the actual cost of fuel purchased. The figures in this column as well as in the fifth and last vertical columns are, therefore, not accurate figures based on the amount of fuel used, and have no accurate relation to the third vertical column (pounds per thousand square feet per degree-day). The purchasing of fuel in large quantities, particularly for bituminous coal where we must order in carload lots, makes it practically impossible to purchase just sufficient fuel for one heating season, therefore, we will have varying amounts of fuel left over at the end of the season which, of course, has been paid for, thus increasing the cost for that year. Should our estimate for the following year be fairly accurate and very

FUEL CONSUMPTION FOR SCHOOLS USING BITUMINOUS COAL

SCHOOL		TONS USED	T. PER M. SQ. FT. FL. AREA	LBS. PER M. SQ. FT. PER DEGREE DAY	COST PER YEAR	COST PER M. SQ. FT.	ENROLLMENT	COST PER PUPIL
Boys' High	A	228	3.738	1.522	1054.68	17.31	843	1.25
	P	210	3.477	1.483	1055.82	17.33	916	1.15
George Ross	A	195	5.759	2.285	911.77	26.93	657	1.39
	P	195	5.759	2.478	1065.05	31.45	612	1.74
George Washington	A	159	4.892	1.941	748.47	23.10	600	1.25
	P	154	4.753	2.045	748.94	23.12	607	1.23
Reservoir St.	A	191	9.693	3.846	1006.33	51.14	371	2.71
	P	193	9.807	4.220	967.30	49.15	309	3.13
S. Mulberry St.	A	95	5.612	2.227	411.11	24.35	454	.91
	P	78	4.620	1.988	412.01	24.40	401	1.01
Duke St.	A	94	5.799	2.301	503.20	31.04	328	1.54
	P	75	4.627	1.991	469.24	28.95	284	1.65
Mary St.	A	80	7.026	2.788	431.19	37.99	293	1.47
	P	87	7.665	3.298	520.58	45.86	300	1.74
Prince St.	A	47	5.182	2.056	183.23	20.10	276	.66
	P	45	4.935	2.123	340.10	37.30	238	1.43
Administration Building	A	35	6.073	2.410	169.88	29.90	...	....
	P	38	6.689	2.878	191.37	33.69	...	....
4-Year Average	A	..	5.975	2.375	.....	29.10	...	1.40

A—Average of 4 years, September, 1932, to May, 1936.
P—Present heating season—1936-1937.
Average degree-days—5041.
Degree-days 1936-1937—4648.

FUEL CONSUMPTION FOR SCHOOLS USING ANTHRACITE

School		Tons Used	T. per M. Sq. Ft. Fl. Area	Lbs. per M. Sq. Ft. per Degree Day	Cost per Year	Cost per M. Sq. Ft.	Enrollment	Cost per Pupil
East Jr.	A	582	6.196	2.458	3001.17	31.94	1107	2.71
	P	486	5.167	2.221	2630.93	28.00	1202	2.19
West Jr.	A	450	5.696	2.260	2293.46	29.02	1341	1.71
	P	439	5.554	2.390	2118.60	27.38	1402	1.54
Stevens	A	177	4.649	1.845	1282.01	33.63	864	1.49
	P	189	4.944	2.127	981.20	25.74	915	1.07
Lemon St.	A	92	5.078	2.015	488.29	26.88	466	1.05
	P	90	4.955	2.132	495.46	27.28	440	1.13
Fremont St.	A	105	6.117	2.427	552.22	32.25	484	1.14
	P	89	5.168	2.224	486.43	28.41	450	1.08
Rockland St.	A	94	5.475	2.172	588.24	34.35	385	1.53
	P	87	5.051	2.173	471.22	27.52	401	1.18
Strawberry St.	A	68	5.302	2.104	351.63	27.32	284	1.24
	P	72	5.554	2.390	388.22	30.16	264	1.47
Pearl St.	A	77	6.110	2.424	423.72	33.84	317	1.34
	P	74	5.910	2.543	430.14	34.35	246	1.75
Chestnut St.	A	85	6.858	2.721	513.92	41.47	293	1.75
	P	85	6.858	2.951	489.74	39.51	284	1.72
Franklin St.	A	65	5.729	2.273	365.26	32.44	273	1.34
	P	62	5.507	2.370	384.85	34.19	260	1.48
Ann St.	A	70	6.228	2.471	399.10	35.51	202	1.98
	P	69	6.095	2.623	355.56	31.64	122	2.91
Clay St.	A	81	7.336	2.911	607.43	55.35	303	2.01
	P	95	8.611	3.705	556.80	50.74	306	1.82
New St.	A	34	6.221	2.468	260.13	47.60	...	....
	P	47	8.509	3.661	323.06	59.11	...	....
Walnut St.	A	39	8.211	3.258	223.00	47.56	161	1.39
	P	41	8.744	3.762	196.60	41.93	152	1.29
Manor St.	A	42	9.272	3.679	241.58	53.97	149	1.62
	P	41	9.048	3.893	221.72	49.54	109	2.03
4-Year Aver.	A	..	6.299	2.499	.....	37.54	...	1.59

A—Average of 4 years, September, 1932, to May, 1936.
P—Present heating season—1936-1937.

little fuel remains at the end of the next season, it can be readily understood that the actual cost for the next season will be considerably lower.

The columns representing cost per year are, however, the figures used in the final calculation of total costs for the operation of each building, and the grand total for all buildings, therefore, they are used in these analyses.

The fifth and last vertical columns which have to do with cost, I believe are self explanatory. The figures representing average costs per year are fairly accurate, particularly in the fifth vertical column headed "cost per thousand sq. ft." as they are based on a constant figure. The final column headed "cost per pupil," will vary each year with the enrollment, as well as with the total cost.

These studies have revealed many interesting facts concerning our buildings and their use. One of these comparisons is found between the East Junior High School and the West Junior High School. These two buildings were designed and built by the same architect at approximately the same time. The East Junior High School contains 93,968 sq. ft. of floor area while the West Junior High School contains 79,044 sq. ft. of floor area. Naturally the larger building will require more fuel and a higher cost per year. However, I would call your attention to the four year average figures in the second and third vertical columns which indicate that the East Junior High School building used considerably more fuel per thousand square feet than the West Junior High School building. The figures in these same columns for the present heating season indicate the conditions reversed which show the results of a special effort at the East Junior High School building to operate this plant more efficiently, which to a small extent was due to a shipment of a better grade of fuel given us by the coal contractor without additional cost. Our fireman reported that this high grade fuel permitted him to extend his firing periods from 35 minutes with the fuel contracted for, to 60 minutes with the better grade of fuel.

Another interesting comparison between these same buildings is indicated in the "enrollment" column which shows that the larger East Junior High School building houses fewer pupils by far than the smaller West Junior High School building, which makes a decided increase in cost per pupil in the larger building. Comparisons of the cost per pupil with the four year average figure at the bottom of the table show up this difference very distinctly. . . .

ABSTRACTS of Current Papers, Books and Pamphlets

Water Supply and Air Conditioning

As a result of a large number of requests for information on city water supply and air conditioning, the Department of Commerce undertook a survey of the actual water supply situation in all of the cities of the United States in which the water authorities served a population of 100,000 or over. This is a report on the results of this survey.

It was found that the increasing use of air conditioning apparatus is a matter of growing concern to the officials of many municipal governments. Thirty-eight of the ninety-two cities reported upon informed the Department of Commerce that steps had already been taken or were being considered to limit the water-using air conditioning equipment.

A number of cities are now using the full capacity of their water systems and are not in a position to furnish additional water until the systems have been enlarged. Many other large cities throughout the United States are now using from 75 to 90% available water capacity and could not readily furnish additional large quantities of water for purposes other than those now using water without arranging for an increased capacity.

The report points out that in a number of cities the water disposal problem is just as serious or more serious than the water supply problem. When the large quantities of water from air conditioning systems are discharged into the regular sewerage system a great burden is placed on the sewerage facilities and in a number of cities it has been necessary to restrict the use of such air conditioning plants.

The report is divided into six sections, each section dealing with a different aspect of the problem. Subjects covered include The Problem of City Water Supply to Meet the Demand for Air-Conditioning-Equipment Service; Available Water Supply of Cities of 100,000 Population and Over, January 1, 1937; Total Annual Delivery of Water and Percent of Annual Change in Cities of 100,000 Population and Over, 1931-1936, Inclusive; Service Capacity of Present Water Works Systems in Cities of 100,000 Population and Over, January 1, 1937; Effect of Air-Conditioning Installations on Water Supply in Cities of 100,000 Population and Over, January 1, 1937; and Temperature of Water at Main Outlet and Normal Mean Temperature for Selected Months in Cities of 100,000 Population and Over, in Fahrenheit Degrees, 1936.

This report should be of considerable value to manufacturers and marketing executives engaged in the selling and installation of air-conditioning equipment, since it allows them to recognize that in a great many cases sales efforts on certain types of their merchandise cannot succeed in some cities regardless of the selling effort used. Thus there are a number of cities wherein the available supply of water is barely equal to current demand. Obviously any efforts to sell installations designed to draw their water supplies from the city sources will fail in such communities, since it will be impossible to obtain the necessary water service.

It should also be of value to the designing engineer since it gives the monthly temperatures of the water at the main outlets and shows how these temperatures compare with the normal monthly mean air temperatures.

[*"Effect of City Water and Sewerage Facilities on the Market for Air Conditioning Equipment," by O. C. Holleran and published by the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C.; Market Research Series No. 16; heavy paper cover; 49 pages; 8½ x 11 in.; price, 10c.*]

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Oil Fuels and Burners

Recently the author of this book prepared a course on oil burners for the Education Bureau of the United States Navy. This book is an extension of the course so as to cover not only the marine applications but also industrial and building heating applications. The author's purpose is to present an informational manual intended especially for the needs of service men, salesmen, mechanics, electricians, and engineers.

The subject has been treated in a complete manner starting with a history of petroleum and following through the combustion to the heating and insulation of the house. The book should give the reader an excellent knowledge of the field of oil burning even though he has only a slight technical education. In discussing the various subjects, the author presents typical applications and equipment rather than showing particular makes and models. A list of chapter headings follows: Oil Fuels; Combustion of Oil Fuels; Atomization of Oil Fuels; Oil Burners; Automatic-Control Devices; Oil-Fuel Tests; Heat Measurements; Calculation of Heating Systems; Calculation of Heating Requirements; Estimating Savings from Heat Insulations of Walls and Roofs; Fans and Blowers; Draft and Chimneys; Air-Conditioning Tests.

[*"Oil Fuels and Burners," by James A. Moyer. Published by McGraw-Hill Book Co., New York; cloth cover; 6 x 9 in.; 375 pages; price, $4.*]

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Conductivity of Building Materials

Since 1920 the Engineering Experiment Station and Bureau of Technological Research at the University of Minnesota has been carrying on a program of research in the field of heat transmission. From time to time reports have been made of the results of this program. In this present bulletin the essential parts of previous publications, together with the results of work not previously reported on, have been coordinated to give a complete picture of the heat transmission work which has been conducted to date at the University.

The first part of the work was directed to the development of test methods and apparatus for determin-

ing the thermal conductivity of homogeneous materials and built-up wall sections. Later the test methods and apparatus were used to study the thermal conductivity of various types of materials and combinations of materials as used in building construction; also to analyze the heat flow through built-up wall construction and to determine the laws governing such factors as surface conductance, air space conductance, and the thermal properties of homogeneous materials.

A list of chapter headings in this bulletin follows: Nomenclature and Definitions; Heat Flow Discussion; Conductance of Air Spaces; Transmission by Bright Metallic Surfaces; Thermal Properties of Wood; Results of Tests on Walls by Hot Box Method; Discussion of Results of Wall Tests for Figures 78 to 93; Concrete Construction; Factors Affecting Conductivity of Walls; and Overall Heat Transmission Coefficients by Calculation.

[*"Thermal Conductivity of Building Materials," by Frank B. Rowley and Axel B. Algren. Bulletin No. 12 of the Engineering Experiment Station University of Minnesota, Minneapolis, Minn. Paper or cloth cover; 6 x 9 in.; 134 pages; price, paper cover, $1; cloth cover, $1.50.*]

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Duct Construction

The importance of correctly designed ducts is recognized throughout the entire air conditioning industry and as a result of this there is available a considerable amount of information on the subject. The same thing cannot be said of the fabrication and installation of ductwork and detailed information on these subjects is rather difficult to obtain.

This book is to be welcomed because the author has made an effort to present a practical manual on the modern methods of fabricating and installing sheet metal work. No attempt is made to cover the engineering phase of duct design except in a few cases to establish the reason for certain types of constructions.

A list of the chapter headings follows: Materials Commonly Used; Shop Arrangements and Equipment; Methods of Fabricating Round Pipes; Planning for Installation; Longitudinal Seams in Ducts; Cross Seams for Ducts and Stacks; Practical Methods of Hanging Ducts; Fabricating Rectangular Elbows; Turn-Blades in Elbows; Typical Branch and Main Connections; Dampers and Regulators; Diffusers, Vent Heads and Grille Connections; Heater Casings and Housings; Heater and Air Washer Housings; Setting Fans and Making Connections; Insulation of Ducts; Vital Points About Ducts in Residences; Practical Use of Automatic Controls; Ventilating Hoods; Examples of Duct Calculations; Taking Off Quantities in Duct Work; Weight of Metal Required for Rectangular Elbows; "Stringing Rivets" and Other Blowpipe Kinks; Spray Cooling Tower; Production Forms for Ventilation Work; Diagonal Bracing of Ducts; and Labor Saving in Soldering Large Blowpipe.

[*"Duct Construction," by O. W. Kothe. Published by the Sheet Metal Publication Co., 45 W. 45th St., New York. Imitation leather binding; 5⅜ x 8 in.; 270 pages; price, $3.*]

BRIEF REVIEWS

EXHAUST AND VENTILATING SYSTEMS. There is a regulation of long standing in New York State to the effect that before installing a new ventilating system in a factory, or making any changes in an existing system, plans must be filed with the Department of Labor and approved. This applies not merely to plants where orders have been issued requiring that the ventilation be improved because dusts, gases or fumes have been found to be present in quantities tending to injure the health of the workers but also to plants where an employer, entirely on his own initiative, desires to install new ventilating equipment of any sort, or to make any changes in existing installations in his plant. This article outlines in brief some of the conditions to be fulfilled in submitting specifications for plans so that these may be approved without undue loss of time. [*"How to Prepare Plans for Exhaust and Ventilation Systems," by John H. Vogt in the Industrial Bulletin published by the Industrial Commission of New York State, Albany, N. Y. Volume 16, No. 4, April 1937, pages 138 to 140.*]

BIG BUSINESS. This book is the result of a two-year study by a group of trained economists to find an answer to the question, "How Profitable is Big Business?" It is an effort to translate the problem into simple terms which the average man can understand. [*"How Profitable is Big Business?," published by the Twentieth Century Fund, Inc., 330 W. 42nd St., New York; cloth bound; 5½ x 8 in.; 201 pages; price, $2.*]

STATISTICS. Practically all current trade statistics published daily, weekly, monthly, or quarterly by 40 governmental agencies and 200 non-governmental agencies are covered in a new book entitled "Sources of Current Trade Statistics," published by the Bureau of Foreign and Domestic Commerce. Approximately 3000 statistical series are listed with names and addresses of the compiling agencies. [*"Sources of Current Trade Statistics," Market Research Series No. 13. Published by the Bureau of Foreign and Domestic Commerce, Washington, D. C. 8 x 10¼; planographed. Obtainable through Superintendent of Documents; price, 25 cents.*]

WELDED PIPING DESIGN. Complete handbook information on design and layout of piping for welded connections. Subjects treated of interest to engineers are fundamentals of welded joint design; welding metallurgy; standard welded pipe connections; design data on welding cast iron, galvanized iron, stainless steel and non-ferrous piping; advantageous layout; fabrication and erection considerations; welded anchors and supports; and welding speeds. [*"Design of Welded Piping," published by The Linde Air Products Co., Union Carbide & Carbon Corporation, New York. Paper cover; 197 pages; 6 x 9 in.*]

DUST CONTROL. Rules of the Industrial Board of the New York State Department of Labor relating to the control of silica dust in rock drilling, effective May 1, 1937. [*"Industrial Code Bulletin 33, Industrial Board, State Department of Labor, Albany, N. Y.*]

NEWS OF THE MONTH

Plans for Chicago Power Show Develop

CHICAGO—Combined buying forces based on economics and location auger well for the Chicago Exposition of Power and Mechanical Engineering, to be held at the New International Amphitheatre here October 4-9. Plans for the Exposition have been greatly advanced during recent weeks and the list of exhibitors at this date gives assurance that Chicago will witness a power show outstanding in terms of companies represented and comprehensive in terms of the products displayed.

Cutting power costs is always an important objective in the purchasing of new plant equipment and in the modernizing of that which is becoming obsolete. Power saving may be secured through replacement or modernization of equipment in several departments, notably in the boiler room, and in heating, ventilating and air conditioning. In each of these fields there is a strong buying movement.

Materials and equipment on display will include fuels, combustion units, steam generating and distribution systems, piping and fittings, prime movers, pumps and hydraulic equipment, electric generators and motors, equipment to handle electrical transmission and distribution, control apparatus, instruments of precision, power driven machinery, machine tools, materials handling systems, heating, ventilating and refrigerating machines, air conditioning systems, lubricants, refractories and insulation. Special exhibits will be devoted to the problems of factory cleaning, industrial lighting and the insulation of pipe lines.

The exposition is under the direction of Charles F. Roth, president of International Exposition Co. His headquarters are at Grand Central Palace, New York.

Boston A.C. Bureau to Hold Annual Meeting at Swampscott

BOSTON, MASS.—The Air Conditioning Bureau here has announced through Daniel Ricker, secretary, that its fourth annual outing is to be held at the New Ocean House, Swampscott, on Friday, September 24. Mr. Ricker expects many nationally known executives and engineers of the air conditioning industry to be guests of the Bureau for the occasion. A most interesting program of golf, sports and entertainment has been arranged and it is expected that the outing will be the finest affair ever put on by the Bureau. Events are scheduled to start at 9 a.m. and continue throughout the whole day, and closing with a banquet to be served at seven in the evening.

A.C. Sales Set Record

WASHINGTON—Installed cost of equipment sold by the members of the Air Conditioning Manufacturers' Association in June broke all monthly records but one in the history of the industry, totalling $10.7 million as compared to June sales last year of $6.7 million, an increase of 59.8%.

March sales of slightly more than $17 million marked the only other month exceeding $10 million. The continuing volume of room cooler and small summer comfort installations sent the first half year total to $60.8 million which is 20% higher than the total for all last year.

A.C. for Indian Railway

BOMBAY — Equipment for air conditioning five passenger coaches which will be tried as an experiment on Indian railways has arrived here. These air conditioned coaches were expected to be ready by June 1 but various delays have put this date back to September. Extra fare will be demanded for travel in these coaches.

Brooklyn Poly Offers Night A.C. Courses

NEW YORK—Evening instruction in heating, ventilating, and air conditioning is offered by the Polytechnic Institute, Brooklyn, during the regular 1937-38 school sessions, according to Prof. E. F. Church, Jr., head of the department of mechanical engineering. Classes will be held on Wednesday and Friday evenings, with registration for the first session in heating and ventilating during the week of September 13. This course covers the basic elements of air conditioning with relation to the engineering design and selection of equipment for modern domestic and commercial heating and ventilating systems. Problems will be given illustrating the application of various systems to residences, apartments, office buildings, schools, factories, and theaters.

Beginning in February, 1938, the course in air conditioning will deal with advanced phases and will present fundamental psychrometric principles and their application to cooling, humidifying and dehumidifying of air for central station or unit type systems.

Both courses of instruction will be presented by John James, a graduate of Oregon State College and University of Wisconsin, and a member of the technical staff of the ASHVE.

A.C. Goes to Dogs

SEATTLE—The Western Veterinary Hospital here recently installed air conditioning. Dr. G. A. Ruggles, the owner, says "Dogs recovering from operations and illnesses ought to have an abundance of fresh air free of odors from other dogs."

Charles Henry Hodges

BOSTON—Charles Henry Hodges, first vice-president and member of the executive committee of American Radiator Co. and chairman of the board of Detroit Lubricator Co., died August 7 in the Massachusetts General Hospital here. He was 77 years old.

A member of the executive committee and a director of American Radiator from the time of its organization in 1891, Mr. Hodges was treasurer of the company until 1905 when he retired from active service because of ill health. He again took up active work some years later as head of Detroit Lubricator, founded by his father in 1877.

Max Breitung

BRONXVILLE, N. Y. — Max Breitung, 45, president of Alfol Insulation Co., New York, was stricken with a heart attack August 19 while playing tennis and died five minutes after being admitted to a hospital.

Mr. Breitung was born in Germany and came to this country in 1911. He founded the Alfol Insulation Co. five years ago.

H. H. Dugdale

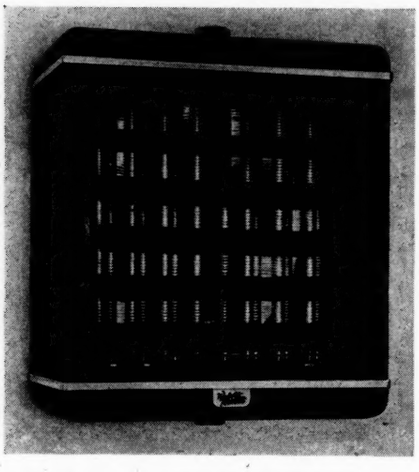
NEW YORK—H. H. Dugdale, 46, vice-president in charge of sales of American Gas Products Corp., died July 19 in the Manhattan General Hospital of a heart attack after a short illness.

Mr. Dugdale entered the employ of A. H. Wolff Gas Radiator Co., predecessor of American Gas Products, in Chicago in 1924 and was shortly made assistant sales manager. He was sales manager of American Gas Products Corporation for ten years, and was named vice-president in charge of sales in February 1936. He is survived by his wife and a sister.

REFRIGERATION SERVICE ENGINEERS' CONVENTION COMMITTEE

General convention committee of the Refrigeration Service Engineers' Society which will hold its fourth annual convention at the Stevens Hotel, Chicago, November 3-5. (Left to right) Front row: Chairman Herman Goldberg, Ray Polley, R. L. Hendrickson, Fred Roth, George Monjian, Ogden Armstrong, Irving Alter. Second row: Joe Corso, Arvid E. Karlberg, George Franck, Arnold Schroeder, Ralph Vanston, Horace H. Blythe. Rear row: Ray Johnson, Harold T. McDermott, Edmund W. Scotten, Barton B. Dawes, William Hauber, Harry Drownes, Willis Stafford. Percy Bossert was the only committee member not present.

NEW EQUIPMENT



Webster-Nesbitt Unit Heaters

NAME—Webster-Nesbitt unit heaters.

PURPOSE—For heating stores, shops, offices, garages, and like buildings.

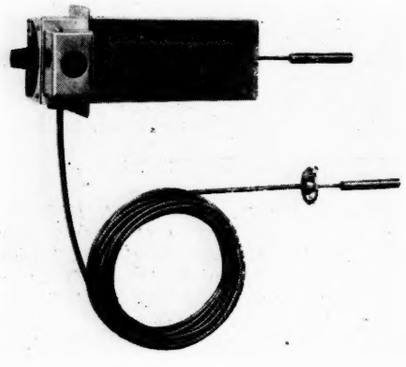
FEATURES—Casings are styled to harmonize with modern store and shop interiors but the unit is so constructed that it can be used equally well in industrial applications. Three types of heating elements are available affording a wide range in final temperatures for various air volumes. Heating unit is constructed of copper fins, mechanically forced over ¾-in. seamless, hard-drawn copper tubes. Steam and return headers are of heavy seamless, rectangular steel tubing with connection couplings and tube bosses arc welded to the header body. All assemblies are rated for steam pressures of 150 lb. per sq. in. Steam and return connections are located in the center of the headers permitting the 12, 16 and 20 series units to be supported directly from steam piping. It is recommended that the larger sizes be supported by hanger bolts. Fans are of the four-blade type to handle large volumes of air with minimum noise. Motors are provided with rubber-isolated bases. Discharge louvers are individually adjustable and may be locked into position. Heater is finished in a black featherweave finish with a stainless steel trim.

SIZES AND CAPACITIES—Six sizes with air capacities ranging from 860 to 4950 c.f.m.

MADE BY—*John J. Nesbitt, Inc., Philadelphia, Pa., and sold by Warren Webster & Co., Camden, N. J.*

Automatic Duct Temperature Controllers

NAME AND MODEL NUMBER—Duct temperature controllers, type LD-2.

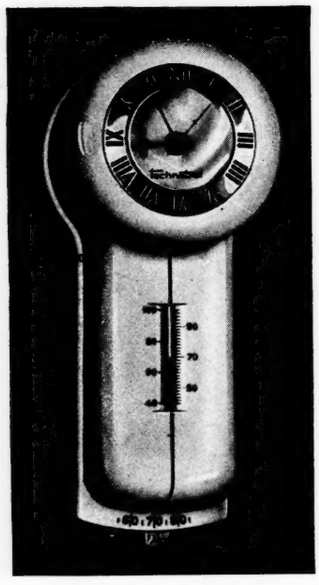


PURPOSE—To maintain a balance between the return air and discharge air temperatures in air conditioning and heating applications in order to prevent sudden changes in discharging first cold and then hot blasts of air.

FEATURES—Main control thermal element is affected by the return air temperature. This helps the discharge air thermal element (each compensating the other) to find the correct discharge air temperature and to maintain the desired return air temperature from its two control locations. Temperature changes are transmitted by the use of a Bourdon tube operating pure silver contacts. The Bourdon tube is incorporated in the main control head and adjusts itself to the constant air temperature changes. The thermal control element extending from the Bourdon control tube head transmits any small change of temperature immediately to the tube causing the control instrument to respond to slight temperature variations. Discharge air thermal element is equipped with 22 ft. of capillary armored tubing and return air control and discharge thermal control are equipped with flanges for mounting on ducts.

TYPES AVAILABLE—Series 20, high and low voltage; series 30, positive and floating action; and series 40, modulating control.

MADE BY—*Automatic Temperature Control, Inc., 101 Park Ave., New York.*



White Thermostat

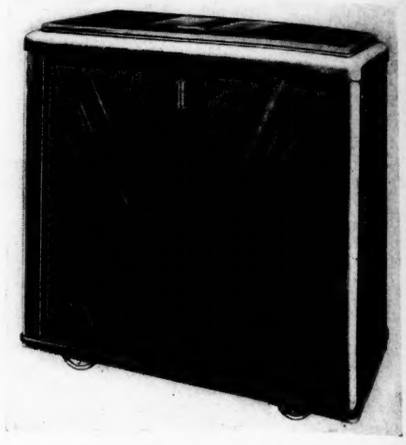
NAME—Technotrol.

PURPOSE—An electric clock controlled, low voltage thermostat for day and night temperature control.

FEATURES—Instrument is equipped with a self-starting electric clock having an indicator to show if it has been stopped because of current failure. Timing mechanism is arranged to automatically lower the temperature at any predetermined time at night and raise it again in the morning. Both night and day temperature settings may be varied from time to time by stop levers accessible on the outside of the instrument. The time may also be varied.

TYPES AVAILABLE—Type B-144 for gradual control; Type B-22 for two-position control. Also furnished with magnetic snap action contacts for both three-wire and two-wire control systems.

MADE BY—*White Mfg. Co., St. Paul, Minn.*



Vitalaire Room Cooler

NAME—Vitalaire ice room cooler.

PURPOSE—For cooling using ice.

FEATURES—The unit is mounted on large rubber-tired casters and can be moved to any desired location where there is an electric outlet. This is the only connection needed. A blower draws the air from the room, circulates it through the unit, and discharges it back into the room. The melted ice water is caught in a pan and is emptied by rolling the unit to a sink and attaching a rubber hose and a water ejector to the water faucet. Connections are available for tapping into a permanent drain or steam and vapor system return. Fan has two speeds, discharging air at either 400 or 250 c.f.m. Maximum ice capacity, 300 lb.; approximate cooling capacity, 2000 cu. ft.

MADE BY—*Ice Cooling Appliance Corp., Morrison, Ill.*

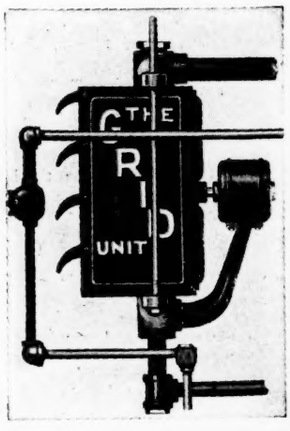
Unit Heater Humidifier

NAME—Grid humidifier.

PURPOSE—A humidifier to be attached either in front of a unit heater or directly behind.

FEATURES—It is said that to install this humidifier no air lines or extra piping are needed. The operation of the humidifier is at temperatures higher than the room atmosphere, which is said to cause quick absorption of the humidifying fluid. The humidifier may be operated with the unit heater or as an individual unit and even though the fan on the unit heater is shut down, the action of the device continues until the desired conditions are reached.

MADE BY—*The Unit Heater & Cooler Co., Wausau, Wis.*



Minneapolis-Honeywell Circulator

NAME AND MODEL NUMBER—Minneapolis-Honeywell water circulator, Types M401 and M403.

PURPOSE—To increase circulation on hot water heating systems.

FEATURES—The device may be used to speed up circulation alone or in conjunction with a Minneapolis-Honeywell flow valve to provide fully automatic summer-winter hot water control. Some of the features include a packless seal which is said to prevent oil from entering the water or vice versa, a standard built-in thermal overload cut-out, stainless steel drive shaft, bronze bearings and a long lasting oil supply.

SIZES—To fit 1, 1½, 2, and 3 in. pipes. 110 volts, 60 cycle motors are standard with other voltages, cycles and currents available.

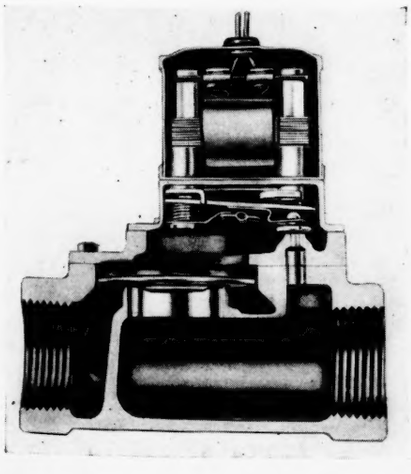
MADE BY—*Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.*

Friez Magnetic Gas Valve

NAME—Magnetic gas valve.

PURPOSE—For controlling the flow of gas to boilers, furnaces, or stoves.

FEATURES—Main valve body is bronze, the floating disk is made of aluminum and valve seat of kid leather. External parts are cadmium plated and internal parts electrically tinned. The entire electrical mechanism and moving parts can be serviced without removing the valve from the pipe line.



METHOD OF OPERATION—Illustration shows valve in closed position. The incoming gas leaks through the clearance around the circumference of the disk filling the upper chamber with gas at line pressure. This pressure holds the disk firmly on its seat as there is only atmospheric pressure below the disk. When the control instrument through the electromagnet lifts the bleeder valve, the pressure above the disk is released to the downstream side. The incoming gas then lifts the floating disk to the top of the chamber and as long as the bleeder valve is open it is held up by the differential of pressure above and below the disk, by the impact pressure from the gas line, and by the wiping effect of the gas flowing around the edges of the floating disk. When the control is satisfied the electric circuit is broken and the relay closes the small bleeder valve. The flow momentarily continues around the circumference of the floating disk until the pressure in the chamber above the disk equals the line pressure, and the disk is then forced down on its seat. Closing process is said to occur in the fraction of a second. It should be noted that the bleed gas joins the downstream flow in the valve itself. Valves operate on 6 volt a.c. from 110 or 220 volt supply through suitable transformers designed for these valves. Electric consumption, 6 watts.

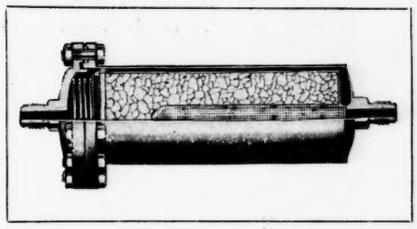
SIZES—Six sizes ranging from ¼ to 1¼ pipe size.

LITERATURE AVAILABLE—Bulletin No. VG.

MADE BY—*Julien P. Friez & Sons, Inc., Baltimore, Md.*

Henry Dehydrator

NAME AND MODEL NUMBER — Henry cartridge dehydrator, type 744.



PURPOSE—For removing moisture from refrigerants.

FEATURES—The dehydrator is easily refilled by inserting the dehydrant cartridge. A dispersion tube for increasing the drying efficiency is incorporated as a part of the refill cartridge. To provide a positive and tight sealing action of the dispersion tube on the inlet fitting and to prevent the bypassing of the refrigerant between the outside of the cartridge and the inner surface of the dehydrator shell a strong spring is provided.

SIZES—Available in three fitting sizes with three dehydrant capacities. The fitting sizes are ¼, ⅜, and ½ with dehydrant capacities of 11.5, 27, and 41.5 cu. in.

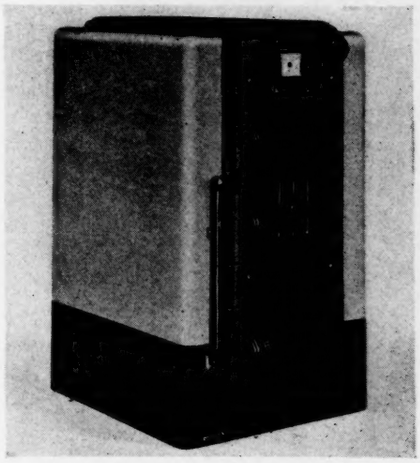
MADE BY — *Henry Valve Co.*, 1001-19 *N. Spaulding Ave., Chicago.*

National Radiator Boiler

NAME—National Radiator residential heating boiler.

PURPOSE—For residential heating using hand, stoker or oil fired.

FEATURES—Boiler is finished in a baked red and black enamel and has rounded corners of the side panels and a double roll at each edge of the center front panels. A foot pedal is provided to open the ashpit door. Control knobs located at the front of the boiler serve as a means of adjusting the damper regulator and smokehood damper. The steam boilers of the hand-fired type have a



built-in domestic heating coil recessed in the back section. On the stoker- and oil-fired types provisions are made for two sizes of storage type hot water heaters. The grate shaking mechanism is made up of six parts, all of which can be removed by withdrawing one cotter-key. A grate lock is provided to lock all of the grate bars in a level position. A special outlet tapping is provided on the front section for water boilers operating with a circulator. The location of this tapping is said to prevent short circuit of the water from the return to the nearest outlet without passing the full length of the boiler when under pressure set up by the circulator.

SIZES—Rating for hand-fired type ranges from 225 to 750 sq. ft. steam and 360 to 1200 sq. ft. hot water.

MADE BY—*National Radiator Corp., Johnstown, Pa.*

Automatic Motorized Valves

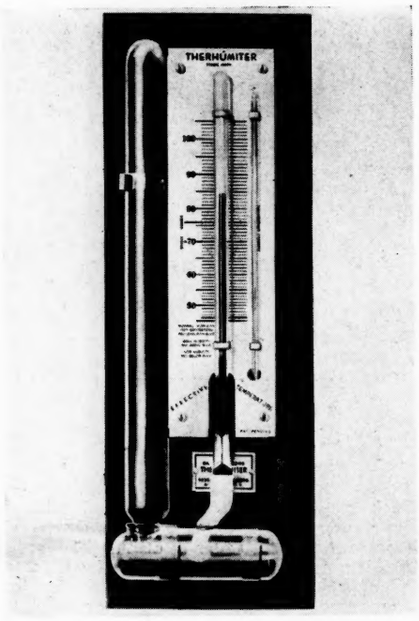
NAME—Automatic motorized valves.

PURPOSE—For controlling the flow of gases and liquids.

FEATURES—The motor unit is of the shaded pole reversing motor type with an integral transformer. Circuit operates on approximately 20 volts. Standard timing for all-on all-off control is 15 seconds, special timing can be furnished. For modulating operation motors must be used in conjunction with special relays; types RM1 or RM2 and modulating controllers.

TYPES AVAILABLE—Type VM1, single seated; VM1-2, double seated; type VM1-3, three-way; and type VPM1-1, pilot operated motorized valve.

MADE BY—*Automatic Temperature Control, Inc., 101 Park Ave., New York.*



Bailey-Parsons Therhumiter

NAME—Bailey-Parsons Therhumiter.

PURPOSE—To indicate effective temperature.

FEATURES—It is said that the Therhumiter will continuously register with permanent accuracy the effective temperature of room air. It is adjusted for air motion up to 150 f.p.m. There are no moving parts, the instrument consisting of a special type tube with two bulbs, one covered with a saturated cloth. A dry bulb thermometer is also supplied. Relative humidity can be calculated by the use of a simple formula printed on the instrument.

PRICE—$15.

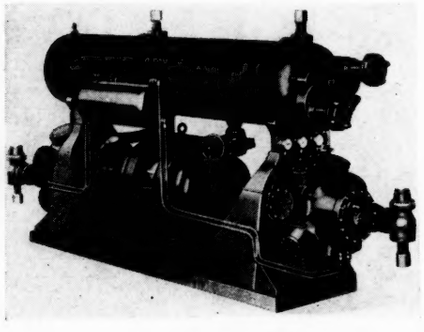
MADE BY—*John R. Parsons, 151 E. 19th St., New York.*

Airtemp Radial Compressor

NAME—Airtemp radial type air conditioning compressor.

PURPOSE—High speed refrigerating compressor for use with air conditioning systems.

FEATURES—Compressors are of the radial type and have either three, five, or seven cylinders placed in a circle around the crankshaft. They operate at a speed of 1750 r.p.m. The manufacturer states that this new type of compressor is light in weight, compact in size, and free from vibration. It is said that they can be installed in practically any part of the building because of their weight and vibration characteristics. It is stated that a floor which supports the compressors when standing still will also support them when they are operating at full speed. Large valve areas combined with small lifts are provided to give quiet valve operation. Auxiliary intake ports are provided at the bottom of each cylinder and these ports are opened by the piston itself as it completes each downward stroke. It is said that the use of the auxiliary ports accelerates intake and thus increases efficiency.



SIZES—From 10 to 75 hp. capacity.

MADE BY—*Airtemp, Inc., 405 Lexington Ave., New York.*

Minneapolis-Honeywell Lo-Water Cut-off

NAME—Minneapolis-Honeywell Lo-water cut-off.

PURPOSE—For protecting steam boilers.

FEATURES—The Lo-water cut-off can be installed according to the ASME boiler code or in the gage glass fittings. It is designed to fit standard half-inch gage glass openings. Copper tube between mountings can be cut to accommodate various center dimensions and shaped to allow for slight misalignments. Switch mechanism may be removed without dismounting the instrument from the boiler. Apparatus is designed for use with pressures not exceeding 10 pounds per sq. in. A manual reset is obtainable at slight additional cost to necessitate manual attention to restore burner operation.

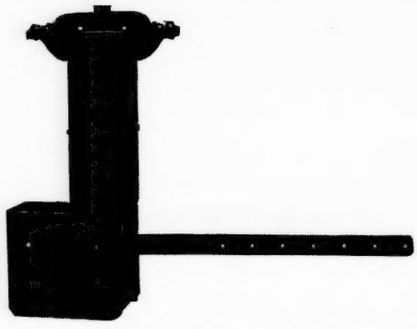
MADE BY—*Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.*

Taylor Lever Motor

NAME—Motosteel Evenaction lever motor.

PURPOSE—For the operation of dampers, lever-operated valves, butterfly valves, and electric rheostats.

FEATURES—Power of either up-stroke or down-stroke can be increased or decreased by a spring adjusting nut. The lever action can



be reversed by substituting another lever and by transposing the fixed and movable pivots. It is said that there is a uniform relation between the air pressure applied to the diaphragm motor and the resulting lever travel throughout its stroke. A number of take-off holes are provided throughout the length of the lever so that the force or travel of the motor may be adjusted. The motor may be operated by remote control, by an electro-pneumatic switch, or by a pneumatically-operated controller.

SIZES—Three sizes of motors. In terms of maximum damper areas which can be positioned, the sizes are 25 sq. ft., 50 sq. ft., and 110 sq. ft.

MADE BY—*Taylor Instrument Companies, Rochester, N. Y.*

Detroit Radiator Venting System

NAME AND MODEL NUMBER—Ideal fast-venting system consisting of Arco-Detroit No. 300 Multiport for radiators and a No. 861 Hurivent for mains.

PURPOSE—For quick venting on one pipe steam systems.

FEATURES—These venting valves incorporate an automatic modulator which is said to eliminate all the obstacles to large port venting without sacrificing any of its advantages. Valves are said to vent at maximum port opening until the pressure rises to approximately 2 oz. and then automatically revert to a port opening proper for the normal pressure. The No. 861 Hurivent is said to vent approximately 22 times as fast as the average vent valve and the No. 300 Multiport is said to vent approximately three times as fast as the average air valve. The Multiport for radiators carries a manual adjustment which reduces its maximum port opening by any amount needed to compensate for the size and location of the radiators. The adjustment of the Multiport is said to be proportional to the movement of the adjusting arm. A muffling chamber on the Multiport is designed to stop objectionable noises. It is also said that should loose scale prevent valve closure under water, the molded jacket will prevent splitting. The Multiport has a jet black jacket trimmed with chromium.

MADE BY—*Detroit Lubricator Co., Detroit.*

Holcomb & Hoke Stoker

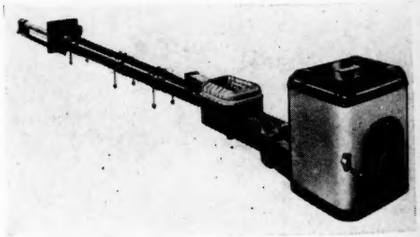
NAME—Bin-Feed FireTender.

PURPOSE—For automatic firing of coal from bin.

FEATURES—Special cleanout opening is provided in the worm housing to give access to the point where large objects which work their way into the worm housing can be easily removed. Transmission, motor and fan unit are completely enclosed in a container insulated with sound-absorbing material. A variable pitch feed screw is used. Transmission has only two gears and is lubricated by a flow of oil from a top reservoir. An automatic switch disconnects the motor in case of obstruction in feed screw. Controls include low voltage thermostat, relay, limit control and hold-fire control. Feed worm is cast of high grade alloy steel.

CAPACITY—Coal burning capacity ranges from 12 to 35 lb. per hr.

MADE BY—*Holcomb & Hoke Mfg. Co., Indianapolis, Ind.*



(New Equipment concluded on page 84)

For Forced Circulation

Heating Lines

Anaconda Copper Tubes make rustable piping obsolete!

Anaconda Copper Tubes are phosphorus-deoxidized to increase corrosion resistance.

Anaconda Fittings have long cups to give longer and stronger solder bond and more support for tubes.

HERE'S the best value and the most attractive appearance in piping for hot water heating installations with forced circulation.

Reduced resistance to flow. The permanently smooth interiors of copper tubes and fittings reduce friction . . . give 10% to 15% greater velocity of circulation with the same head.

Smaller-size tubes. The faster flow through copper makes it possible to use smaller-size tubes and fittings.

Heat losses are less. Usually, the heat given off by uninsulated copper lines is no more than desirable for heating the basement.

Cost little more. An installation of Anaconda Copper Tubes and Fittings costs very little if any more than piping that rusts.

Anaconda Copper Tubes and Anaconda Solder-type Fittings in sizes from ⅛" to 8" are available at leading supply houses. There is an Anaconda copper-tube fitting for *every* heating requirement.

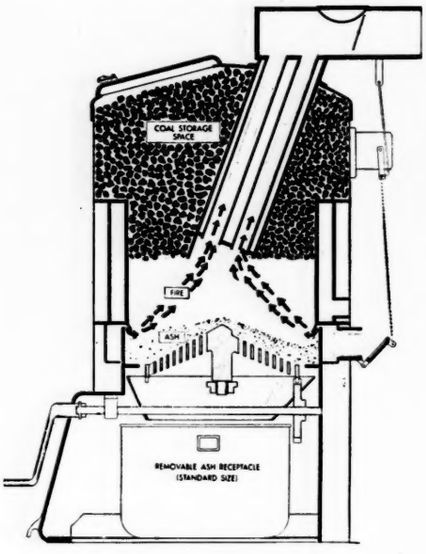
3742

ANACONDA
from mine to consumer

Anaconda DEOXIDIZED *Copper Tubes*

THE AMERICAN BRASS COMPANY · GENERAL OFFICES: WATERBURY, CONNECTICUT

Offices and Agencies in Principal Cities · In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ontario



Burnham Coal Boiler

NAME—Anthra-Heat magazine feed coal boiler.

PURPOSE—For heating medium-sized homes with steam or hot water using anthracite.

FEATURES—This boiler was developed in cooperation with the Anthracite Industries, Inc. It has a gravity magazine feed and it is said that one charge of chestnut coal will last for one or two days in cold weather and three to four days in mild weather. The manufacturer claims that a perfectly balanced combustion is secured due to the fact that air is introduced from the sides and flows across the spiral cone-shaped grates. The sides of the boiler and a water-jacketed smoke pipe are used for absorbing heat. The rotation of the grate throws ashes off at the rim and into a removable receiver. Fuel storage, 290 lb.; ash storage, 31 lb.

SIZES AND CAPACITIES—Steam rating, 190 sq. ft.; water rating, 300 sq. ft.; overall height, 53½ in.; overall width, 31 in.; floor space needed, 31 x 26 in.

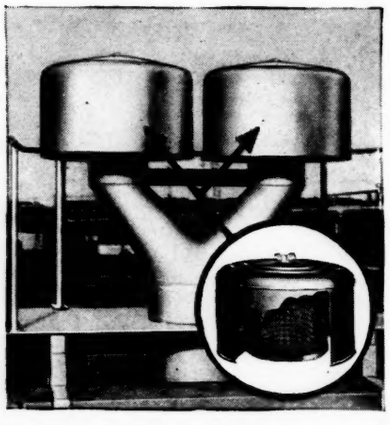
MADE BY—*Burnham Boiler Corp., Irvington, N. Y.*

Air-Maze Air Filter

NAME—Multimaze.

PURPOSE—An all-purpose filter for use with air conditioning installations, internal combustion engines, air compressors, and blowers.

FEATURES — The manufacturer states that for certain types of air conditioning installations the Multimaze units are more suitable than panel filters in that they take less space, are better protected against the weather, and are easily maintained. The Multimaze is a cleanable metal fabricated air filter. The air cleaning efficiency is claimed to be better than 99% with a pressure loss of less than ⅛ in. of water. Illustration shows a typical exterior multiple installation of two hooded units. Inset shows construction details.



SIZES AVAILABLE—For various sizes of internal combustion engines, air compressors, blowers, and air conditioning systems.

MADE BY—*Air-Maze Corp., 812 Huron Road, Cleveland, Ohio.*

Sampsel Zone Control

NAME—Sampsel zone control.

PURPOSE—A zone control system for use with any type of heating system, steam, hot water or warm air, oil, gas, or stoker fired.

FEATURES—The manufacturer states that this zone control makes possible the heating of large residences, apartments, and other buildings with one simple warm air heating plant. Each zone may be controlled at a different temperature. The desired temperature of each zone is controlled by a thermostat. A heat call from the thermostat in any zone will open the volume damper in the duct or pipe leading to that zone. The same thermostat call will also start the stoker and blower, or oil burner and blower, as the case may be. When the thermostat in the zone calling has been served, the volume damper will close and also shut down the stoker or oil burner. However, if a second or third zone should call for heat before the first zone has been served, the stoker or oil burner will continue to operate until all zones are served. Any number of zones can be served at one time and the volume damper in zones served will be closed immediately when the thermostat is satisfied. The last zone served will stop the stoker or oil burner.

MADE BY—*Sampsel Time Control Inc., Mendota, Ill.*

Kool-Kleen Air Conditioners

NAME—Kool-Kleen air conditioner.

PURPOSE—For cooling rooms using ice.

FEATURES—It is said that the unit dehumidifies, washes, and recirculates the air by passing it through a refrigerated fog chamber. The second stage of cooling is obtained by passing the air over a solid cake of ice. The dust and foreign particles which are removed from the air are deposited on the eliminator plates which can be removed and cleaned. A control is provided to vary the amount of cooling or for shutting off the action of the fog chamber and air washer. The conditioner is equipped for three-speed operation. Included with the unit is a water pump and hose which is used to prepare it for re-icing. When new ice is added the free end of the hose is placed in a sink and the motor turned on. It is said that it takes just a few minutes to empty the water from the unit. The unit is portable and requires only an electrical connection.

SIZES—Made in two sizes, the No. 150 with an ice capacity of 150 lb. for rooms with approximately 150 to 200 sq. ft. of floor space; No. 300 has an ice capacity of 300 lb. for rooms between 200 and 300 sq. ft. of floor space.

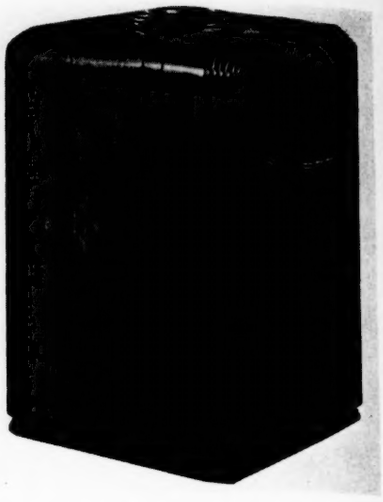
MADE BY—*Kool-Kleen Air-Conditioning Co., Newton, Iowa.*

Hexcel Humidifier

NAME—Hexcel Aristocrat humidifier.

PURPOSE—To increase humidity in room air.

FEATURES—The unit is of the vapor type in which the vapor is generated by a heating element. Water compartment holds 3½ gal. of water and it is said that the humidifier will emit 1 1/5 pt. per hr. An automatic switch shuts off the current when the water supply is exhausted. Unit resembles a table type radio and has an outer casing of two-tone walnut wood. Can be used with either a.c. or d.c. current.



SIZE AND PRICE—18¾ in. high x 14¾ in. wide x 12 in. deep; list price, $37.50.

MADE BY—*Hexcel Radiator Co., Racine, Wis.*

Mercoid Explosion Proof Control Cases

NAME—Mercoid explosion proof control cases.

PURPOSE—To prevent explosions caused by electrical sparks.

FEATURES—The switch used on all Mercoid automatic controls consists of a glass tube containing sealed contacts and a quantity of mercury to make or break a circuit. In these controls there are no open arcing, oxidation or corrosion but there are places so hazardous that a double protection against explosion is essential. It is for such places that the new explosion proof cases are utilized to completely protect the electrical installation. This is done by completely enclosing the automatic controls in an explosion proof case. Explosion proof encased automatic controls are produced for a variety of applications, including pressure controls for pressures from 0 to 2500 lb. and temperature controls for temperatures from — 30 to + 450F are available. Transformer relays and lever arm and float operating controls can also be encased.

MADE BY—*The Mercoid Corp., Chicago.*

Iron Fireman Feed Unit

NAME—Swivel-type automatic feed unit for coal stokers.

PURPOSE—A swivel worm-conduit for stoker coal which permits the location of the coal bin anywhere within a 180° arc in front of the burner unit.

FEATURES—Previous automatic feed conduits required installation of the coal bin in direct line with the burner. This new swiveled worm-conduit makes it possible to install the coal bin at any angle within 180°.

MADE BY—*Iron Fireman Mfg. Co., Cleveland, Ohio.*

McALEAR *announces*

No. 1600 Series
Motorized Valves

MOTORIZED VALVES

for control of steam, water, air, gas or oil in various types of heating systems

● Thirty years experience in designing and manufacturing electrical, pneumatic, and other power-operative valves and controls for special application in all fields of industry, qualifies McAlear's engineering staff to design and produce the finest assembly of motor-driven valve equipment available.

The McAlear Series 1600 Motor-driven Valves are especially suited for use in zoned heating systems or in cases where the system is split, part operated directly from the heating plant and part zoned off and controlled by the McAlear Motorized Valve. Also used for remote control of oil pump supply lines and in air conditioning systems.

These valves may be operated by any type of 3-wire control (thermostat, remote push-button control, etc.) or through a relay. They may be mounted in any position. They provide a positive on and off control and are suitable for service on pressures up to 350 pounds. Valve sizes ½ to 6 inches and in motor timings from 15 seconds to 360 seconds.

Write today for full particulars of McAlear's New Motorized Valve Line, describing your particular problems and the types of valve control in which you are interested.

THE McALEAR MFG. CO., 1909 South Western Ave., Chicago, Ill.

AUTOMATIC CONTROLS FOR TEMPERATURE, PRESSURE, LIQUID LEVEL AND FLOW

Summer Degree-Hours — An Estimating Unit for Summer Air Conditioning

Continuing a monthly service in HEATING & VENTILATING covering summer dry-bulb temperatures in 31 cities

THERE is a fair amount of evidence that that part of the cooling load in air conditioning which depends on the outdoor dry bulb temperature is proportional to the number of hours the temperature is above 85F. The calculation of the number of these degree-hours in the summer depends on the availability of hourly dry bulb temperature readings and for that reason data can not be prepared for all cities. However, the table below gives the number of degree-hours for July and cumulative total to July 31 for 31 cities.

The degree-hour unit is similar to the degree-day unit used for winter estimating, differing however in one important respect—the number of degree-days in a given month in a given city usually compares within ± 20% of the number for the same month in other years; this is not the case with degree-hours which fluctuate all the way from zero to over 800 in the same month in different years. Consequently, the unit does not lend itself to predicting as does the degree-day unit. However, it does enable one to make comparisons of a part of the sensible heat load, with the temperature variable eliminated.

Summer Degree-Hours (Above 85F), July, 1937

July, 1937	July, 1936	City	Year, 1937, to July 31	Year, 1936, to July 31
693	905	Baltimore	951	1224
778	1014	Birmingham	2036	2708
463	3241	Bismarck	712	3886
274	160	Boston	373	207
9	97	Buffalo	16	107
182	588	Chicago	355	723
353	1883	Cincinnati	580	2560
50	525	Cleveland	57	552
334	1272	Columbus	434	1722
795	4012	Des Moines	1222	4663
231	1179	Detroit	267	1238
277	1796	Fort Wayne	315	1918
429	1425	Grand Rapids	518	1460
1181	810	Houston	2280	2046
298	2273	Indianapolis	424	2634
1505	4765	Kansas City	2444	6806
367	994	Memphis	1123	2480
231	740	Milwaukee	323	783
763	2245	Minneapolis	896	2384
826	961	New Orleans	1646	2203
405	315	New York	430	345
505	636	Philadelphia	593	847
189	745	Pittsburgh	256	880
28	15	Portland, Oreg.	111	45
594	640	Richmond, Va.	959	1160
567	3687	St. Louis	1135	4889
673	1345	Savannah	1606	2122
0	0	San Diego	0	0
0	0	San Francisco	1	0
288	1201	Toledo	326	1307
508	840	Washington	719	1176

LYCOMING COUNTY HOME Loyalsock Township Pennsylvania
W. D. Shollenberger, Architect. E. Keeler Co., Heating Contractor; both of Williamsport, Pennsylvania.

ILLINOIS HEATING SYSTEMS

—a complete Pneumatic Zone Control Installation

ONE of Pennsylvania's finest County Homes, this new structure near Williamsport, is outstanding—both in construction and equipment, in a beautiful architectural setting.

The heating system is an ILLINOIS 7 zone installation. From a control board in the pump room all zones are regulated, either manually or by thermostat. Two steam vacuum pumps (one used as a standby) maintains 20 inches of vacuum in the return lines.

Thus, maximum comfort, ease of control to prevent over heating, fuel economy and low upkeep are assured.

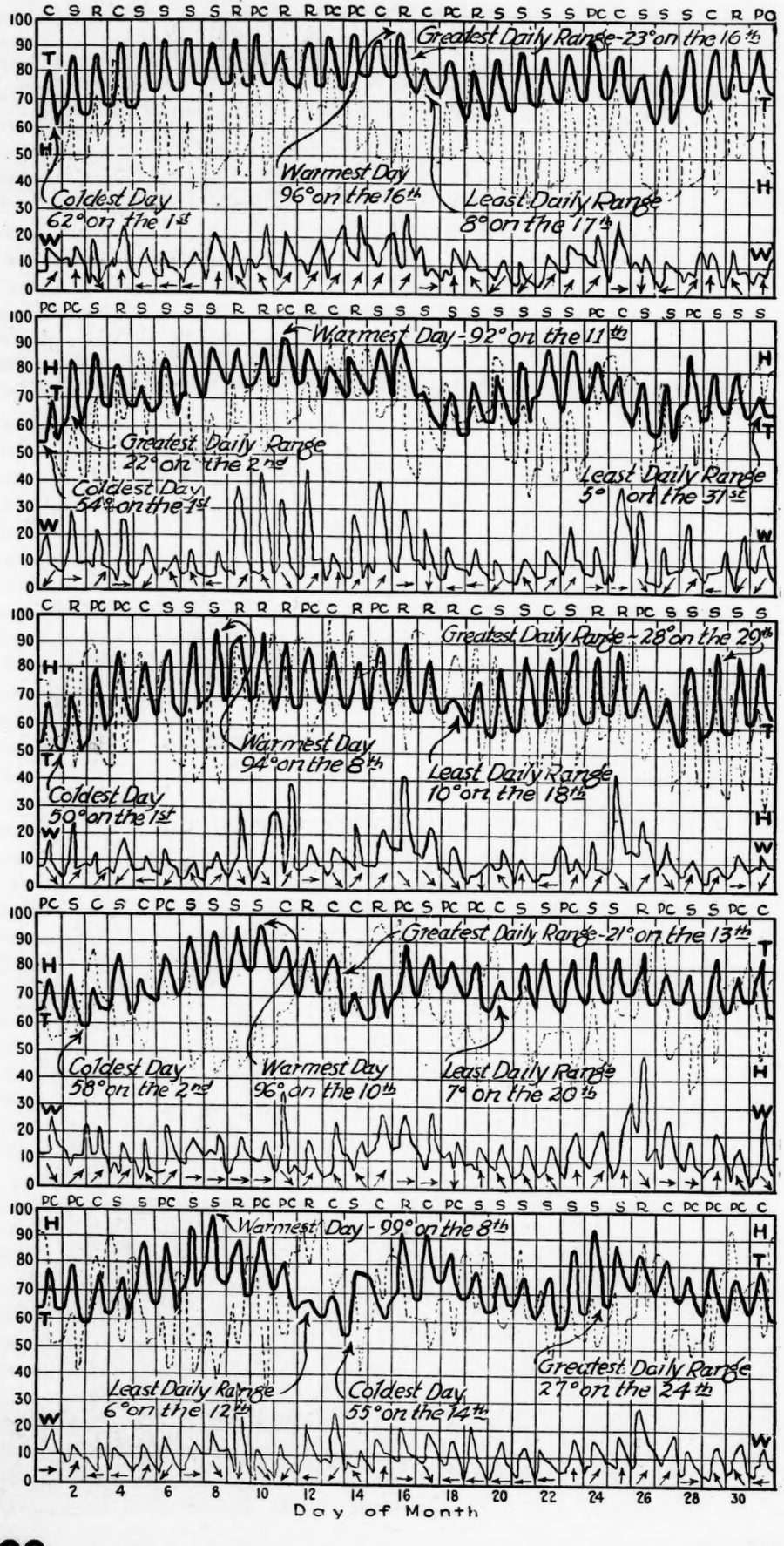
ILLINOIS Pressure Reducing Valves and High Pressure Traps are also used on Kitchen and Laundry equipment.

If you are concerned with economy in steam consumption for any purpose, it will pay you to investigate ILLINOIS Heating Systems and Steam Specialties. Write for bulletins today.

ILLINOIS ENGINEERING COMPANY
2047 SOUTH RACINE AVENUE, CHICAGO

THE WEATHER FOR JULY, 1937

Plotted from records compiled for HEATING & VENTILATING by the U. S. Weather Bureau. Heavy curves (T), dry bulb temperatures in deg. F.; dotted lines (H), per cent relative humidity from readings at 8 a.m., noon, and 8 p.m. Light lines (W), wind velocity in m.p.h. Arrows indicate prevailing wind directions, north being arrow pointing up, etc.; S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.


Greatest Daily Range-23° on the 16th
Warmest Day 96° on the 16th
Coldest Day 62° on the 1st
Least Daily Range 8° on the 17th
Warmest Day-92° on the 11th
Greatest Daily Range 22° on the 2nd
Coldest Day 54° on the 1st
Least Daily Range 5° on the 31st
Greatest Daily Range-28° on the 29th
Warmest Day 94° on the 8th
Coldest Day 50° on the 1st
Least Daily Range 10° on the 18th
Greatest Daily Range-21° on the 13th
Coldest Day 58° on the 2nd
Warmest Day 96° on the 10th
Least Daily Range 7° on the 20th
Warmest Day-99° on the 8th
Least Daily Range 6° on the 12th
Coldest Day 55° on the 14th
Greatest Daily Range 27° on the 24th
Day of Month

St. Louis

Mean temp. for month, 79.8F; aver. wind velocity, 9.8 m.p.h.; prevailing direction of wind, SW.

Chicago

Mean temp. for month, 74.4F; aver. wind velocity, 8.3 m.p.h.; prevailing direction of wind, SW.

Pittsburgh

Mean temp. for month, 72.9F; aver. wind velocity, 8.7 m.p.h.; prevailing direction of wind, SW.

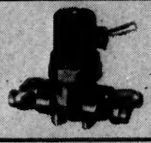
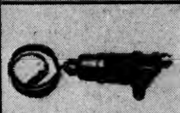
New York

Mean temp. for month, 75.4F; aver. wind velocity, 11.1 m.p.h.; prevailing direction of wind, W.

Boston

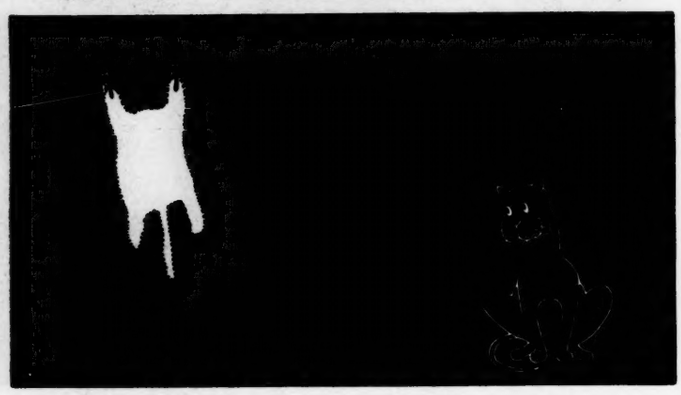
Mean temp. for month, 73.2F; aver. wind velocity, 8.5 m.p.h.; prevailing direction of wind, SW.

"GENUINE DETROIT" Controls

HOW IT LOOKS	WHAT IT IS	WHERE IT IS USED	WHAT IT DOES
	TWO ELEVEN ROOM THERMOSTAT	In either high or low voltage control circuits of heating and air conditioning installations.	Controls operation of burner motor, Solenoid Valve, damper motor, or Thermotor gas valve in accordance with changes in room temperature.
	NO. 197 HUMIDISTAT	In either high or low voltage control circuits of air conditioning or humidification installations.	Controls the operation of solenoids, motor operated valves, damper motors, relays, heaters, compressors or fans in accordance with changes in humidity.
	NO. 691 DIFFERENTIAL THERMOSTAT	In low voltage circuit for summer air conditioning installations.	Automatically controls operation of cooling unit to maintain a specified difference between indoor and outdoor temperatures. Prevents "Over-Cooling".
	NO. 431 Duct Damper Motor UNIT	On ducts for forced air conditioning systems.	Operates duct damper and Automatic Stoker, Oil or Gas Burner in response to zone thermostat.
	NO.683-R3 & 683-W2 SOLENOID VALVES	In the liquid or suction line of refrigerating units and in the water supply line of humidifiers.	Controls the flow of refrigerant or the flow of water in response to action of thermostat, pressure switch or humidistat.
	NO. 686 SOLENOID VALVE (Large Capacity)	Large Capacity valve for refrigeration liquid or suction lines or water supply lines.	Controls flow of refrigerant or water. Operated by pressure, temperature or humidity control.
	NO. 250 Series CONTROLS FOR REFRIGERATION	In commercial refrigeration and air conditioning systems.	Controls operation of compressor in accordance with changes in temperature, pressure or vacuum. Available with or without high pressure cutout.
	NO. 673 THERMOSTATIC EXPANSION VALVE	In liquid line to evaporator coil of cooling and refrigeration installations.	Keeps evaporator full of refrigerant at all times, avoiding temperature lag or motor overload in starting.
	No. 781, 783 & 785 THERMOSTATIC EXPANSION VALVES	Large capacity valves used in liquid lines to evaporating coils of large air conditioning installations.	Keeps evaporator completely refrigerated and entire system in perfect balance.

DETROIT LUBRICATOR COMPANY
DETROIT, MICHIGAN • 5900 TRUMBULL AVENUE
Division of American Radiator & Standard Sanitary Corporation
Canadian Representative — RAILWAY AND ENGINEERING SPECIALTIES LTD.
MONTREAL, TORONTO, WINNIPEG

THERE'S MORE THAN ONE WAY TO SKIN A CAT!

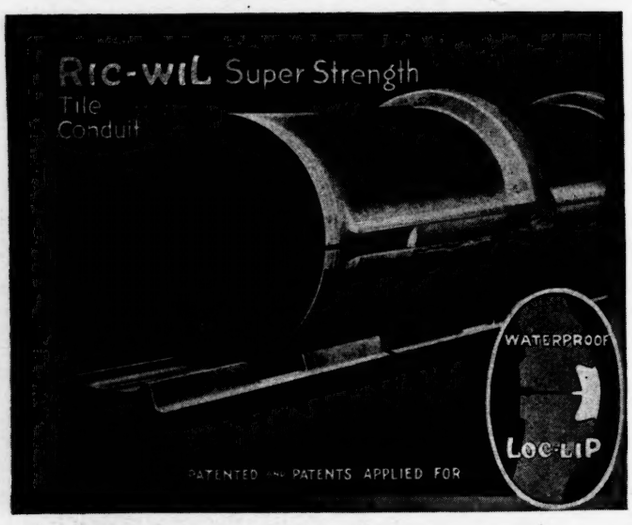


You can skin a cat and make a fur coat—but it won't be much good. You can skin an underground steam conduit job—and save money to pay out in steam losses. Ric-wiL never did it that way. In material and manufacture, the Ric-wiL idea is that permanent efficiency is worth what it costs. If you want a makeshift system, you don't want Ric-wiL. If you want the lowest priced system that will actually operate *economically*—you do want Ric-wiL. We back that up with *thousands* of jobs all over the country.

Water repellence, heat retention, underdrainage, alignment, ease of assembly—all these vital requirements are completely met. Ric-wiL keeps steam lines over 90% efficient. Various designs in Tile or Cast Iron to meet all conditions—famous Dry-paC Waterproof Asbestos Insulation. Submit your underground steam problems to Ric-wiL. Ask for complete catalog with Dry-paC sample for testing.

The RIC-WIL Co., Union Trust Bldg., Cleveland, Ohio
New York San Francisco Chicago
Agents in principal cities

Standard Ric-wiL Conduit is assembled on the job—materials and workmanship can be easily inspected.



REGISTERED IN U. S. PATENT OFFICE

RIC-WIL

CONDUIT SYSTEMS FOR UNDERGROUND STEAM PIPES

WITH THE MANUFACTURERS

American Air Conditioning Corp., Sebastopol, Calif., has been formed to take over the manufacture of the French automatic oil burners and oil burning furnaces. This company will also manufacture a line of air conditioning units, fan and filter cabinets, attic cooling fans, and hot water heaters. Officers of the corporation are: *L. E. French,* president and general manager; *M. French,* vice-president; *James A. Perry,* secretary-treasurer.

American Rolling Mill Co., Middletown, Ohio, has appointed *G. F. Ahlbrandt* and *W. W. Lewis* assistant vice-presidents, and *H. M. Richards* has been named manager of the sheet and strip sales division.

Apex Electrical Manufacturing Co., Cleveland, has purchased the Zephyr air conditioning division of Savage Arms Corp., Utica, N. Y. Machinery used in production of air conditioning units at Utica will be moved to Cleveland and installed in the Apex company's Bessemer Avenue plants.

Carraway-Byrd Corp., Dallas, Texas, has elected *A. F. Loecher* executive-vice-president and general manager. He will have charge of all production and sales activities. Mr. Loecher was formerly an executive of Westinghouse Electric & Manufacturing Co.

Consolidated Edison Company of New York, Inc., New York, has appointed *W. A. Hunter* sales manager of its wholesale business. Mr. Hunter was formerly assistant secretary and sales manager of the New York Steam Corp. Reporting to Mr. Hunter in his new position are the wholesale business bureau, *C. W. Meytrott,* manager, and the coke sales bureau, *R. C. Miller,* manager.

Fedders Manufacturing Co., Inc., Buffalo, N. Y., has opened a new factory branch in Detroit at 1036 Beaubien St., with *Leo J. Freitas,* former Dallas branch manager, in charge. The Detroit branch will provide factory engineering service and a large warehouse stock. *Horace I. Schmidt* has been named manager of the Dallas Branch.

Hoffman Specialty Co., Waterbury, Conn., has appointed *Arthur C. Roy* sales manager of the metropolitan New York district. Mr. Roy was formerly advertising and sales promotion manager of the air conditioning division of General Electric.

Iron Fireman Manufacturing Co., Portland, Oreg., has completed a series of 19 district sales conventions preparing for fall sales. Speakers at the meetings were *E. C. Sammons,* vice-president; *C. T. Burg,* general sales manager; and *Dale Wylie,* sales promotion manager. Special days were devoted to engineering problems. *E. C. Webb,* engineering service manager, and *R. L. Harlow* were the speakers.

The Mercoid Corp., Chicago, has opened a new office at 1035 Cathedral St., Baltimore, Md. *John Jex, Jr.*, is manager.

Minneapolis-Honeywell Regulator Co., Minneapolis, has moved its branch offices in Boston, Pittsburgh, and Indianapolis to new and larger quarters. The Boston office is now at 797 Beacon St., occupying the second floor. The new location of the Pittsburgh office is 26th and Sarah Sts., and the Indianapolis district office is now at 1134 N. Pennsylvania St.

Morse Chain Co., Ithaca, N. Y., has announced that it has changed the name of its stoker which was formerly known as the Morse Automatic Fuel-Saver to Templux. Templux manufacturing headquarters are at the Ithaca, N. Y., factory of the Morse Chain Co., with sales offices at the Detroit factory. The company has appointed *Nides-Cloud, Inc.* Chicago distributor of the Templux stokers.

Nash-Kelvinator Corp., Detroit, has appointed 13 distributors of its Kelvinator line of commercial products in New York, Illinois, Texas, Wisconsin, Ohio, and Connecticut.

John J. Nesbitt, Inc., Holmesburg, Philadelphia, Pa., has announced that on September 1 *Warren Webster & Co.*, Camden, N. J., through its sales offices in principal cities became exclusive national distributor for industrial unit heaters manufactured by Nesbitt. A new industrial unit heater has been announced and is described elsewhere in this issue. Inquiries concerning this product should be addressed to Warren Webster offices. This arrangement does not affect existing marketing plans for the Nesbitt Syncretizer unit which will continue to be sold by Nesbitt representatives and American Blower Corporation; Nesbitt heating surface is sold by manufacturers of fan system apparatus.

Pangborn Corp., Hagerstown, Md., has named *M. I. Dorfan* dust control specialist. Formerly manager of the Blaw Knox Dust Division, which was recently taken over by Pangborn, Mr. Dorfan will act as general field representative. His office is in the Chamber of Commerce Building, Pittsburgh.

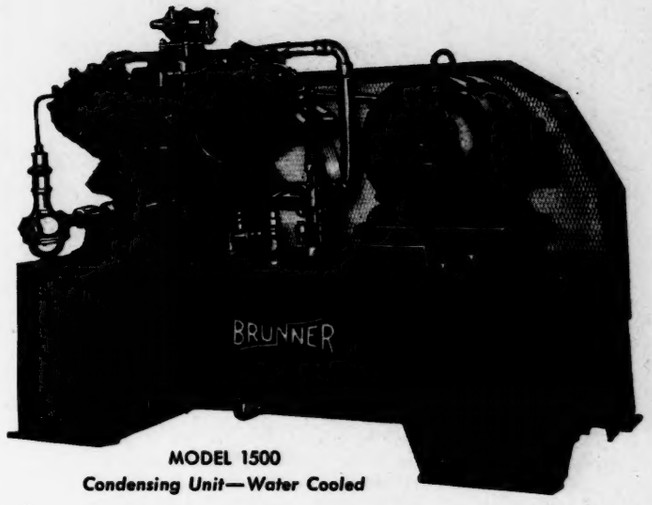
Penn Electric Switch Co., Goshen, Ind., has named *J. G. Moravec* manager of its Moline, Ill., office, with headquarters at 535 Fifth Avenue Building. This office opened July 1, will serve western Illinois and Wisconsin, Minnesota, Iowa, Nebraska and Dakota. Mr. Moravec was formerly sales engineer in the company's Des Moines office.

Penn Electric Switch Co., Goshen, Ind., has named *Paul O. Penn*, formerly manager of the company's Detroit office, assistant to Malcom E. Henning, executive vice-president. Mr. Penn will be located at Goshen. *P. L. Tolerton* has been appointed manager of the Detroit office.

Republic Steel Corp., Cleveland, Ohio, has appointed four distributors of its tubular products: *Bluefield Supply Co.*, Bluefield, W. Va.; *Ormand Plumbing Supply Co.*, San Antonio, Tex.; *J. Gaber Co.*, Houston, and *Morgan's Inc.*, Savannah.

Whiting Corp., Harvey, Ill., has appointed *R. F. Gray* special factory representative to assist the company's distributors and dealers in the stoker division.

THINKING IN TERMS OF *Super*-DUTY?



MODEL 1500
Condensing Unit—Water Cooled

LOOK TO BRUNNER!

THE condensing unit is no place to take chances with dependability! And especially where the demands for air conditioning service are severe and where constant operation is of vital importance. *That's the spot for Brunner equipment.* • • • Brunner Condensing Units are engineered for SUPER-DUTY, in every sense of the word. You can depend on them to stand up under heavy loads, quietly and uncomplainingly . . . to serve for many years without interruption . . . to provide effective refrigeration at minimum power and up-keep cost. • • • Specify BRUNNER on your next installation—and get a *practical* demonstration of the reason why Brunner is the "Fastest Growing Name in the Industry". The Brunner line includes fifty-eight condensing units—air and water-cooled—ranging from 100 pounds to 15 tons of refrigeration. Write: Brunner Manufacturing Company, Utica, N. Y., U. S. A.

BRUNNER
Condensing Units

Bellevue-Stratford Hotel, Philadelphia

PROVIDE BALANCED HEAT IN BELLEVUE-STRATFORD

World-Famous Philadelphia Hotel Carries Out Webster Heating Modernization Program

PERFECT COMFORT FOR GUESTS

Philadelphia, Pa.—The world-famous Bellevue-Stratford Hotel took advantage of the opportunity to provide better heating service for guests by installing the Webster Moderator System of Steam Heating early in 1936.

Because the Webster Moderator System supplies continuous mild heat to each of the Bellevue-Stratford's 2,518 radiators, there is no on-and-off heating with its alternate "cold 70" and overheating. Room temperatures are adequate at all times regardless of changes in outdoor weather conditions.

F. J. Malloy, Chief Engineer of the Bellevue-Stratford, states: "Our chief concern has always been to provide perfect heating comfort for guests regardless of the severity of the weather. With the Webster Moderator System, we have achieved that result."

Although better accommodations for guests was their principal objective, performance records show that the Bellevue-Stratford substantially reduced the cost of heating by installing the Webster Moderator System.

Prior to modernization, Webster engineers estimated that coal consumption would be reduced 150 tons during March and April, 1936, the period set aside for the working out of operating procedure. Just how accurate this estimate proved to be is shown by the fact that actual fuel savings during March and April, 1936, amounted to 154 tons.

These before-and-after facts point the way to maximum comfort and economy in heating new buildings as well as in modernization of existing installations. Consult your architect, engineer or heating contractor. Or address

WARREN WEBSTER & CO., Camden, N. J.
Pioneers of the Vacuum System of Steam Heating
Representatives in 60 principal U. S. Cities—Est. 1888

WEBSTER MODERATOR CONTROL "Controlled by the weather"

The Standard Lime and Stone Co., Baltimore, Md., has appointed *Eugene E. Kresge* district sales representative covering the Illinois and Wisconsin district of the company's rock wool insulation division. *Joseph M. Daffron* has been named district sales representative covering the southwestern territory.

Whiting Corp., Harvey, Ill., has named the *Graybar Electric Co.*, Pittsburgh, exclusive distributor of its stoker for 24 counties in western Pennsylvania, 10 counties in eastern Ohio, and 14 counties in West Virginia. Graybar will have a special department for selling stokers, headed by *R. A. Bartley*, who is also merchandising manager for all other products handled.

L. J. Wing Mfg. Co., New York, has appointed *R. F. Hamilton*, 381 Gas & Electric Building, Denver, to represent it in Colorado, Wyoming and New Mexico.

NEW CATALOGS

(Unless otherwise indicated the publishers of catalogs will supply copies on request without charge.)

ANEMOSTAT CORPORATION OF AMERICA, 551 Fifth Ave., New York. A standard-size, 16-page catalog on the Anemostat high velocity air diffuser. An Anemostat is a device for injecting high velocity air into a room without drafts. Catalog describes features and operation of the Anemostat, shows numerous typical applications and gives specifications and data.

AUTOMATIC TEMPERATURE CONTROL, INC., 101 Park Ave., New York, has published two standard-size catalogs dealing with its controls. The first presents information on the line of automatic controls for modulation and positive action in heating and air conditioning, gives information on room thermostats, duct temperature controllers, compensating air conditioning controllers, temperature controllers, automatic controllers, supersensitive automatic controllers, relays, modulating relays, control panels, control dampers, and control motors. The second catalog deals with the all-weather micro-balanced heat control system, gives information on the features of this type of control system, describes the design considerations, zoning and the various controls and valves used. Information on savings resulting from such systems is also included.

CARRIER CORP., 850 Frelinghuysen Ave., Newark, N. J., has published a standard-size, spiral bound, semi-technical manual on centrifugal refrigeration. The booklet has 48 pages and treats the principle and operation of the Carrier centrifugal machine. Also includes engineering data, description of accessories and parts, and thermodynamic characteristics of refrigerants.

FAIRBANKS, MORSE & Co., 900 S. Wabash Ave., Chicago, has published a standard-size attractive booklet entitled "Central System Air Conditioners by Fairbanks-Morse." Booklet discusses various types of air conditioning units and their functions and applications in office buildings, shops, residences and industrial plants. The company's central plant air conditioning systems are described in detail.

FAIRBANKS MORSE & Co., 900 S. Wabash Ave., Chicago, Ill., has published two standard-size bulletins describing the Fairbanks-Morse line of deep well turbine pumps. Bulletin 6920 deals with oil lubricated units, while Bulletin 6920R covers water lubricated units which are used where the water must be kept pure and clean and where oil lubrication is not permissible. Both types are available in sizes from 4 to 16 in. and capacities from 10 to 2300 gal. per min., with lifts ranging to 400 ft.

GARDEN CITY FAN Co., Chicago, has published three standard-size catalogs of its line of fans. Catalog No. 220 describes Design B multiblade and standard steel plate fans, gives construction features, capacity tables, dimensions, and engineering data on air velocities and properties of air. Catalog No. 36 covers Garden City's non-overload fans, lists the outstanding features and includes capacity tables and a fan designating chart. Catalog No. 370 describes fans for high temperatures from 300 to 1600F. Includes a description of construction features, gives dimensions and capacities and also data on the properties of air.

JOHNSON FAN & BLOWER CORP., 1319 W. Lake St., Chicago, has published a standard-size bulletin, No. 3733, describing its line of propeller fans and roof ventilators. Bulletin gives features, capacities, and specifications, as well as some suggestions on the designing of ventilating systems.

NATIONAL RADIATOR CORPORATION, Johnstown, Pa., have published a standard-size, loose-leaf, 12-page bulletin on the National Heat Extractor boiler. Booklet describes the outstanding features and gives sizes, ratings and dimensions of the Series AH hand-fired, Series AM stoker-fired, and Series AO oil-fired Heat Extractor boilers.

PERFEX CONTROLS Co., 415 W. Oklahoma Place, Milwaukee, Wis., has published two price sheets, one covering controls for the stoker industries and the other controls for the oil burner industry. These price sheets are really condensed catalogs since they show both an internal and external picture of each control, give a brief description of the application and a catalog listing in tabular form for ready reference.

C. J. TAGLIABUE MFG. Co., Brooklyn, N. Y., have published a 56-page catalog, No. 1060C, entitled "TAG Indicating and Recording Temperature and Pressure Instruments." Gives complete data on indicating and recording controllers for temperature and pressure, recording thermometers, recording pressure gages and dial-indicating thermometers.

WILLIAMS OIL-O-MATIC HEATING CORPORATION, Bloomington, Ill., have published an attractive standard-size booklet giving the latest information on the Williams Air-O-Matic year 'round air conditioning unit. This unit is designed to give complete summer and winter air conditioning by the use of low pressure steam. Summer cooling is provided by an Air-O-Matic absorption unit. Two four-color drawings are used to illustrate the operation of the unit.

REFRIGERANT
CONTROLS
Florist Refrigerator by
Pasadena Refrigerator Mfg. Co.
for
LONG LIFE &
CONTINUED
CUSTOMER
SATISFACTION
Controls on any kind of Air Conditioning or Refrigeration equipment, are assurance of dependability, durability, accuracy, and economy. They are "tops" in trouble-free operation.
Definite reasons for A-P perfection are found in the A-P Factory. Materials and operation are given severe scrutiny before and during manufacture, and especially after the control is completed. No A-P Control ever leaves the factory or laboratory without complete proof of its accuracy.
When you stake your reputation on the trouble-free service of an installation, you need A-P Thermostatic Expansion Valves.
Progressive Jobbers Everywhere
Stock A-P Controls
AUTOMATIC PRODUCTS COMPANY

Hank

tells how to have 40% less Radiators

The old timey radiator and our Slenderized, side by side, just so you can see for yourself how that 40% is telling the truth.

That sounds like a lie to start with. Well it 'tis. And it 'taint. To get that saving of 40% less, you ain't saving on the number of radiators. The saving works two ways. First there's a saving of all that 40% in the room they take. Then there's a saving, and not maybe, because of the radiators getting all het-up 40% quicker.

There's no use your thinking, I got some kind of smart trick or other, about cutting down on something, in order to cut up more profits for you, and then get the Devil from you afterwards, because neither one worked out.

All I'm yapping about, is to put you wise to stop using those old timey room-taker radiators and start in a-using the Burnham Slenderized ones, like which there ain't any just like 'em. Some others have tried mighty hard to look like they were like 'em. But it don't take no expert to know they ain't the same breed, nohow.

Furthermore, which is a heck of a lot more than just further, I don't care a hoot how many you tell these facts to. And if you want to know a lot more yet about these Slenderized 40% lessers, there's printin' matter that's chock full of all sich.

Hank Hindle

BURNHAM BOILER CORPORATION

Manufacturers of Heating Equipment Since 1873

Irvington, New York **Zanesville, Ohio**

Foreign Export Department,
116 Broad St., New York

Burnham Boiler

YARNALL-WARING Co., Chestnut Hill, Philadelphia, Pa., has published a standard-size, 16-page bulletin EJ-1906 on the Yarway expansion joints. A considerable portion of the booklet is devoted to explaining the Yarway Gun-Pakt feature of the joint. This feature makes it possible to pack the stuffing box while the joint is under pressure.

YOUNG RADIATOR Co., Racine, Wis., has published catalog 5537 on the Young cooling coils for use with water or brine. Gives capacities and specifications of type W and type K cooling coils, as well as a complete outline of the method of selecting coils for heating and cooling.

COMING EVENTS

SEPTEMBER 27-OCTOBER 1, 1937. 19th Annual Convention, American Gas Association, Hotel Cleveland, Cleveland, Ohio.

OCTOBER 4-6, 1937. Fall Meeting, American Society of Mechanical Engineers, Lawrence Hotel, Erie, Pa.

OCTOBER 4-9, 1937. Chicago Exposition of Power and Mechanical Engineering. International Amphitheater, Chicago. Charles F. Roth, Grand Central Palace, New York.

OCTOBER 5-8, 1937. 66th Annual Meeting, American Public Health Association, Hotel Pennsylvania, New York.

OCTOBER 18-22, 1937. 18th Annual Meeting, American Welding Society, Hotel Traymore, Atlantic City, N. J.

OCTOBER 18-22, 1937. National Metal Exposition (including Welding) Convention Hall, Atlantic City, N. J. W. H. Eisenman, American Society for Metals, 7016 Euclid Ave., Cleveland, Ohio.

NOVEMBER 3-5, 1937. 4th Annual Convention and Exhibit, Refrigeration Service Engineers' Society, Stevens Hotel, Chicago. Herman Goldberg, Chairman, General Convention Committee, 9 S. Clinton St., Chicago.

NOVEMBER 9-12, 1937. 18th Annual Meeting, American Petroleum Institute, Stevens Hotel, Chicago.

DECEMBER 6-10, 1937. Annual Meeting, American Society of Mechanical Engineers, New York.

DECEMBER 6-11, 1937. 16th Exposition of Chemical Industries, Grand Central Palace, New York.

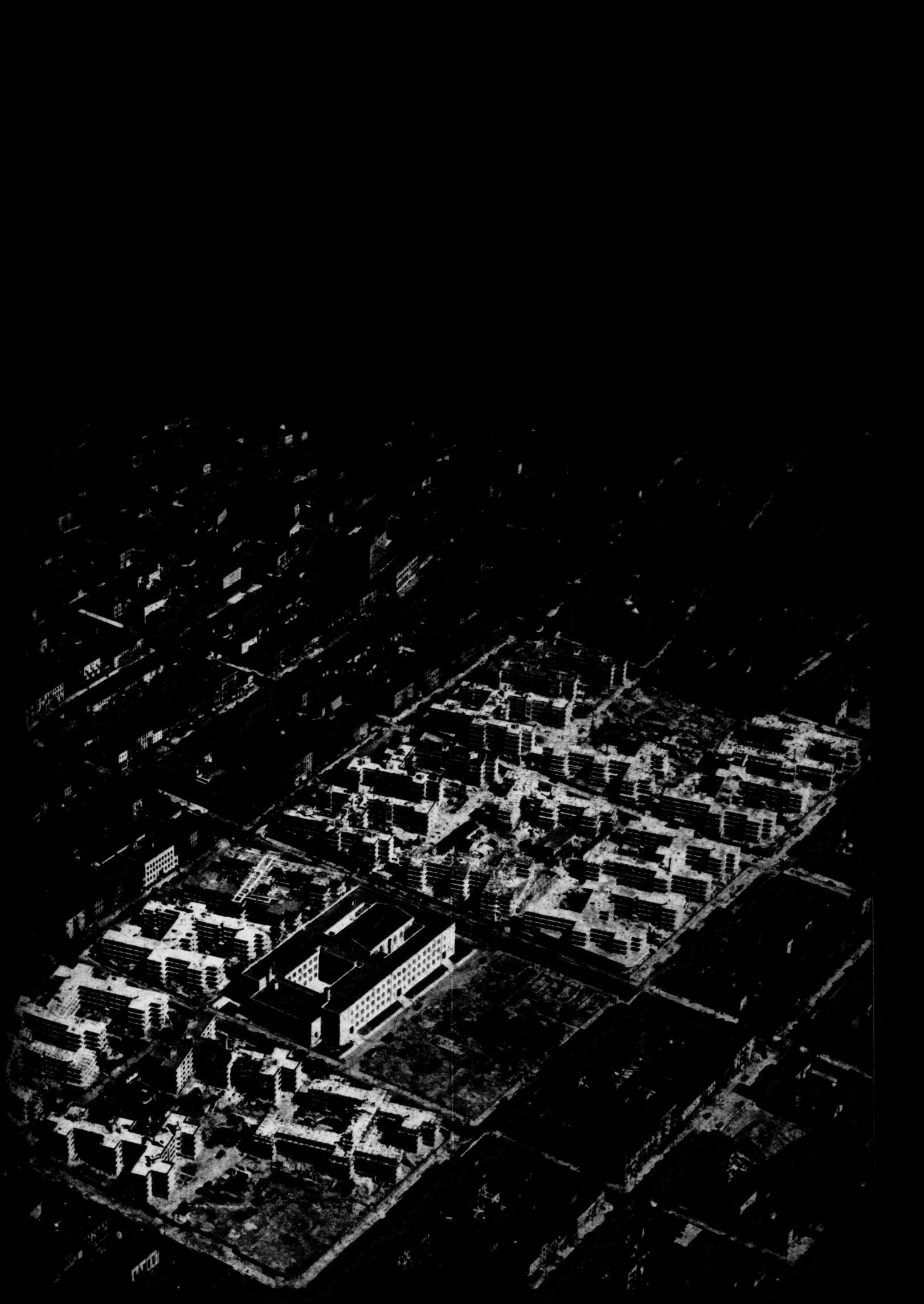
DECEMBER 27-28, 1937. Drying and Air Conditioning, Subject of 4th Annual Chemical Engineering Symposium of the American Chemical Society, University of Pennsylvania, Philadelphia.

JANUARY 24-26, 1938. Winter Convention, National Warm Air Heating & Air Conditioning Association, Hotel Roosevelt, New York.

JANUARY 24-28, 1938. 5th International Heating and Ventilating Exposition, Grand Central Palace, New York. Charles F. Roth, Grand Central Palace, New York.

JANUARY 24-28, 1938. 44th Annual Meeting, American Society of Heating and Ventilating Engineers, New York.

JANUARY 26-28, 1938. 33rd Annual Meeting, American Society of Refrigerating Engineers, Hotel Roosevelt, N. Y.

APRIL 11-16, 1938. Mechanical Equipment Show, Textile Hall, Greenville, S. Car. William G. Sirrine, President, Textile Hall Corp., Greenville, S. C.

DECEMBER 5-10, 1938. 13th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.